READING CORAL IN THE AGE OF DARWIN

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ABSTRACT

Reading Coral in the Age of Darwin

Doctor of Philosophy Dissertation by

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In this dissertation, I argue middle-class Victorians used geological theory and methodology to evaluate coral growth patterns in the context of imperial resource management. Nineteenth-century British publications examined in this case study document that authors employed a geological reading of coral, irrespective of where the natural resource grew, how it was used, or its physical shape. Encouraged by practitioners of the new science, Victorians read coral through a geological lens in the context of empire.

I first demonstrate that Geological Society of London members established an economic framework for coral as an indigenous natural resource in publications addressing general audiences. In *Penny Magazine*, geologist Leonard Horner explained contemporary research, using modified stratigraphic drawings, illustrating the significance of local sources of coral fossil limestone deposits for post-Reform Act readers impacted by evolving British politics. Geological Society and British Geological Survey participants authored British field guides incorporating Charles Darwin's illustrated coral growth theory to visualize the volume of domestic coral reserves and patterns of deposition.

Next, I document that Victorian authors applied a geological reading to coral sourced from colonial and foreign regions to interpret Britain's past, present, and future role in global resource management. In published letters, Sarah Maria Smythe used Darwin's subsidence theory to evaluate access through reefs in pre-annexation Fiji. Smythe's illustrated correspondence demonstrates her application of geology during Royal Botanic Gardens, Kew colonial resource assessments. Robert Hunt, Keeper of Mining Records for the Geological Survey, published guide books for the 1851 and 1862 International Exhibitions framing Mediterranean coral samples displayed Center Court, adjacent to extracted imperial gems, with contemporary geological research. Writing for periodicals including *Art-Journal*, Peter Lund Simmonds argued for geologists to support British interests in foreign and colonial coral markets through continued research in coral growth.

Knowing that Geological Society members authored publications for nineteenth-century British publics, thus establishing an intellectual framework for coral as a substantive component of the subterranean and submarine imperial estate, requires a re-evaluation of the Victorian understanding of coral as a resource simultaneously indigenous and colonial. For Victorians, the map of imperial Britain was the map of coral.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

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READING CORAL IN THE AGE OF DARWIN

INTRODUCTION

When Coral was British

> A bit of ornament and a bauble it is, I grant you; but remember that the coral-insect, though a tiny little gentleman, is more important in one respect than Columbus himself. He is not a finder of islands and continents, but a founder of them. … Man comes at last to take possession of the new estate, and he may well say that the architecture of an insect has laid the foundations of his property.
>
> Thomas Campbell
> *The New Monthly Magazine and Literary Journal*, 1836.[1]

In the early 1830s, Geological Society of London members disseminated their research directly to the Victorian public in the pages of illustrated penny magazines. At that time, British geologists were actively mapping coral limestone strata during field research throughout the empire. They presented their contemporary findings to the general reader through diagrams that revealed the geology of coral spanning both hemispheres and encompassing, as Robert Chambers observed in his people's edition of *Vestiges of the Natural History of Creation*, "South America, the southern part of Africa, and even at the Falkland Islands, the very antipodes of Britain."[2] Equatorial and arctic environments fell within the geological scope.

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[1] Thomas Campbell, "Letters from the South. Letter XVIII," *The New Monthly Magazine and Literary Journal* 46, no. 184 (April, 1836): 420. Reprinted in Thomas Campbell, *Letters from the South*, vol. 2 (London: Henry Colburn, 1837), 45-65.

[2] Anonymous [Robert Chambers], *Vestiges of the Natural History of Creation*, 6th ed. (London: John Churchill, 1847), 34.

Since the late eighteenth century, navigators and missionaries had depicted the *geographic* expanse of visible coral encountered during excursions to Pacific, Indian, and colonial Atlantic Ocean waters. The overall theme of these exploratory narratives was clear, regardless of the message conveyed in specific texts portraying coral growth as both impediment and asset: reefs and islands constructed through the activity of what *The New Monthly Magazine* termed the coral "insect" tangibly and materially impacted Britain's imperial expansion across the surface of the globe.[3] Authors captured the coordinates of the vast expanse of coral-rich regions and compared the scale of newly visualized areas to local geography. "The great Coral-Reef of New-Holland," the *Wesleyan-Methodist Magazine* had announced in 1824, "would reach almost three times from one extremity of England to the other, with the height of Ingleborough, or that of the ordinary and prevailing class of Scottish mountains."[4] Such narratives characterized the coral façade in terms of British landscape and elevation, identifying regions which *Chambers's Edinburgh Journal* and others deemed suitable for British colonization, emigration, and evangelization.[5]

Yet the Geological Society of London and Geological Survey members informed their early nineteenth-century working- and middle-class readers about current field research which recorded the *volume* of coral deposits. They visualized unseen strata as economic resources stored in countryside and urban landscapes. Beginning in the early

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[3] Campbell, "Letters from the South. Letter XVIII," 420.
[4] "And this is the work of [coral] insects, whose dimensions are less than those of a house-fly. – It is perfectly overwhelming." [Anonymous], "The Coral Insect," *Wesleyan-Methodist Magazine* (1824): 466.
[5] "Corals," *Chambers's Edinburgh Journal* 227 (Jun. 4, 1836): 151. "Rise of Land in the Pacific," *Chambers's Edinburgh Journal* 279 (Jun. 3, 1837): 152. Portions of the latter are extracts from "Art. VII. *Revue Politique de l'Europe en 1825*. Paris. Imported by Treuttel and Wurtz," in *The Monthly Review* (Apr. 1826): 407-408; (Rev.) George Croly, "The British Empire," in *The Life and Times of His Late Majesty George the Fourth* (London: James Duncan, 1830), 400-401.

1840s, moreover, Geological Society of London authors used Charles Darwin's coral growth theory to explain to the public why, how, and when Britain's stored wealth was accumulated. Geologists interpreted for readers the genesis of recently-mapped British limestone – England's very "foundation" – in annotated diagrams that visualized historical and ongoing coral activity. In the words of one contemporary, geologists "traced new lines" over recently constructed geographic maps, creating a palimpsest at the intersection of imperial Britain's geological past, present, and future.[6] Thus, layered onto the navigator and missionary narratives was the geologists' emerging tale: coral constructed Britain and its global expanse, in layers of chalk and limestone strata in London and its antipodes, from metropole to periphery.

This project expands our understanding of the nineteenth century British view of global coral and, more broadly, demonstrates the public engagement with the new science of geology. In "Reading Coral in the Age of Darwin," I argue that geologists instructed nineteenth-century Victorian middle-class readers on the relevance of applied contemporary geological theory and practice to the evaluation of British economic resources. This study addresses the impact of readers' subsequent embrace of geological methodology as one element in a Victorian-era toolkit used to frame local evidence of coral growth in the wider context of imperial resource management. Nineteenth-century British authors employed the geology of coral to investigate the empire's emerging global position, and interpreted the activity of the coral "architect," constructing both indigenous and colonial "foundations," as a source of infinite opportunity for scientific, political, and

[6] Edward Forbes, "On the Educational Uses of Museums," *Journal of the Society of Arts* 1, no. 46 (Oct. 7, 1853): 560.

economic expansion.[7] For Victorians, the map of the British empire *was* the map of coral.

My study starts with the premise that the cultural and social framework for the interpretation of Western visualizations of coral has a history. This project looks beyond the twenty-first century reading of images of coral – extracted and displayed as ornaments or depicted in drawings and film recording unseen reefs impacted by climate change – to uncover from archival publications the public conversations about coral encoded in Victorian print. For if, as environmental historian Gregg Mitman contends, images as "physical material artifacts" are "constituted through a set of relations that give them agency," and betray the "dynamic social interactions among people and themes," then the nineteenth century depictions of coral in British print must be interpreted as signifiers of the intersection of geological space and time as understood by the practitioners of the science and their reading public.[8] My interest in the visualization of coral comes out of my engagement with science education during my internship at the American Museum of Natural History's Center for Biodiversity and Conservation and as instructor of environmental science and biology. The images of coral and accompanying narratives in these case studies capture the evolving didactic process through which geologists educated middle-class Victorians and, critically, how readers responded in a manner overlooked by historians investigating nineteenth-century science education through the lens of popularization or public outreach.

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[7] For contemporary accounts of mid-century trends in coral jewelry, see for example "Newest London Fashions for February, 1845," *The World of Fashion: Monthly Magazine of the Courts of London and Paris Fashions, Literature, Music, Fine Arts, the Opera, and the Theatres* 251 (Feb. 1, 1845): 44.

[8] Gregg Mitman, "A Liberian Journey: Notes from the Field on Environmental Humanities and Engagement," keynote address presented at the Curriculum for the New Normal Symposium, University of Pennsylvania, April 14, 2016, accessed April 11, 2018, https://vimeo.com/164465074.

As geologists circulated their arguments based on evidence extracted from local strata, they viewed their contributions to the identification of fossil layers an essential element of Victorian-era imperial resource management. This is not surprising, for as James A. Secord has argued, the Geological Survey members regarded the dissemination of their evidence a salient aspect of their goal to remain relevant – and employed – in commissioned government-funded studies of indigenous British reserves.[9] Yet as geologists published the findings of global field research directly to the general reader along with the underlying methodology, the men of science evaluated in this study sought to instill an economic framework for coral, sourced from indigenous and colonial regions, for the benefit of participants recently engaged in broader political conversations during a period of social reform. Tracing the evolution of illustrated arguments from stratigraphic diagrams employed during "closed door" Geological Society sessions, through annotated woodcut versions published the inexpensive *Penny Magazine*, and finally to customized schematics in popular field guides, this project demonstrates the geologists' determination to educate the post-Reform Act general reader with visual evidence of *contemporary* advances in the field.[10] These illustrated works, I argue, were not popularized versions of field studies, or what Ralph O'Connor characterized as performative or theatrical representations of geological findings, but rather concerted efforts to convey to a broad audience the significance of their scientific investigations

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[9] James Secord, "The Geological Survey of Great Britain as a Research School, 1839-1855," *History of Science* 24 (1986): 223-275.

[10] On "closed door" sessions at the Geological Society, see M. J. S. Rudwick, "Charles Darwin in London: The Integration of Public and Private Sphere," *Isis* 73, no. 2 (1982): 195-196, Martin J. S. Rudwick, *The Great Devonian Controversy* (Chicago: University of Chicago Press, 1985), 26 and James Secord, *Controversy in Victorian Geology: The Cambrian-Silurian Dispute* (Princeton: Princeton University Press, 1986),16-17. Martin J. S. Rudwick, "The Emergence of a Visual Language for Geological Science, 1760-1840," *History of Science* 14 (1976): 149-195.

into the mechanisms through which coral animal activity – both historic and contemporary – impacted the formation of resources within the expanding British imperial domain.[11] Moreover, I argue that contained within close readings of Victorian-era geologists' efforts to educate the public through broadly circulated media are new avenues with which to explore twenty-first century public engagement with issues regarding resource extraction in global fossil-rich regions.

Knowing that the Geological Society members authored publications for the nineteenth-century British public, thus establishing an intellectual framework for coral as a substantive component of the subterranean and submarine imperial "estate," requires a re-evaluation of the Victorian understanding of coral. First, reading nineteenth-century print reveals that English-language publications employed the single term "coral" to identify the limestone secretions of these invertebrate animals. In other words, for Victorians, coral was simply "coral," irrespective of where the natural resource grew, how it was used, or its physical shape. Next, publications during the early nineteenth-century stressed for the general reader that the scientific study of coral resources fell no longer under the purview of French students of men of science including Georges Cuvier, but rather British geological field researchers whose maps extended the efforts of William Smith in the field. Less than two decades after Smith's 1815 publication, *Penny Magazine* articles engaged working class readers in the British geologists' contributions to the identification of coral fossil remains as an economic resource. Finally, Victorians "read" coral – in all its social, economic, and political manifestations – through

[11] Ralph O'Connor, *The Earth on Show: Fossils and the Poetics of Popular Science, 1802-1856* (Chicago: University of Chicago Press, 2007), 2-8.

geological illustrations and texts which portrayed the resource as simultaneously indigenous and colonial during a time of imperial expansion.

In contrast with scholarship which analyzes the Victorian-era understanding of coral in silos or categories based on tangible manifestations such as decorative jewelry, tropical reefs, or the domestic aquarium, I propose that geology serves as a way to interpret evidence in nineteenth-century print of Victorian-era authors' preoccupation with the way in which coral grew and its attendant impact on Britain. Current scholarship on the practical and theoretical aspects of Victorian-era debates concerning coral activity focus on British geologists as both principal participants and audience members.[12] In *Deep History* (2014), Martin Rudwick argued that the Geological Society of London members' acceptance of the outcomes of geological debates that focused on the distribution of fossil evidence in Britain and beyond "[gave] geologists the confidence to make generalizations about the Earth's history that might be valid worldwide."[13] In the chapters that follow, I demonstrate that as Society members offered Victorians access to their debates, they presented an intellectual framework for coral geology that gave *readers* the "confidence to make generalizations" – not only about the past, but about the present and future of imperial Britain.

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[12] Alistair Sponsel, "Coral Reef Formation and the Science of Earth, Life, and Sea, c. 1770-1952" (PhD diss., Princeton University, 2009), chapter 3. Alistair Sponsel, *Darwin's Evolving Identity: Adventure, Ambition, and the Sin of Speculation* (University of Chicago Press, 2018), chapter 10. Rudwick, *The Great Devonian Controversy*. Secord, *Controversy in Victorian Geology*. See also Martin J. S. Rudwick, *Worlds Before Adam: The Reconstruction of Geohistory in the Age of Reform* (Chicago: The University of Chicago Press, 2008), 489-493.

[13] Martin J. S. Rudwick, *Earth's Deep History: How It Was Discovered and Why It Matters* (Chicago: The University of Chicago Press, 2014), 217, chapter 6.

Methodology

> "The symphony was Beethoven's No. 9, otherwise the Coral; thus named because there is so much written – and probably, therefore, so much read – about it."
>
> *Punch* (1882)[14]

Discussions in nineteenth-century print record the evolution of expressions of a discrete identity for coral as a global natural resource integral to British interests. Roderick Nash has termed such a framework a "key cultural index," in which individual words develop cultural weight at particular moments in time.[15] As the *Punch* author contended in the above epigraph, coral was much discussed in print.[16] This survey of nineteenth-century non-fiction English-language texts and illustrations examines coral as a "key cultural index," and identifies how the public used coral geology to frame economic, political, and social questions with scientific evidence. In this project, case studies offer salient examples of conversations in publications which further circulated the contemporary arguments of Geological Society of London members, in a manner which documented the social use of geologists' arguments for the reading of coral in the age of Darwin.

This study employs the methodology of the history of the book, as it demonstrates when, why, and how geologists informed readers about coral in the context of trends in scientific research and concurrent events in Victorian society, and how readers responded by tracing networks of influence made visible through digital text searches for the key

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[14] [Henry Edwards], "Song and Supper," *Punch* (Feb. 18, 1882): 81.
[15] Roderick Nash, *Wilderness and the American Mind*, rev. ed. (New Haven and London: Yale University Press, 1973), vii, xii.
[16] Patrick Leary reminds us that this satirical periodical was "avidly seized upon each week by peers, politicians, and common readers alike" and betrayed themes recognized by a wide segment of the Victorian public. Patrick Leary, *The* Punch *Brotherhood: Table Talk and Print Culture in Mid-Victorian London* (London: The British Library, 2010), 1.

word "coral" and associated phrases.[17] In contrast with projects that narrowly focus on key words demonstrating what Secord has identified as "specificity," this study explores coral as a broad category of investigation.[18] This project conducts close textual analyses of publications dating from 1832, the year marked by the founding of the penny periodicals, and continues through the end of the long Victorian-era. It was not surprising to uncover mid-century references to coral discussed in topics ranging from fashion, jewelry, theft records, and advice columns. One insight derived from a concept map of nearly eight hundred periodical articles, together with coded extracts from primary sources including books, exhibition catalogues, and ephemera, was the evidence that the Victorian print actively engaged with the topic of coral throughout the long nineteenth-century, and preceded and continued beyond the mid-century fascination with jewelry and the aquarium.[19] A second observation drawn from reading ephemeral and commemorative print publications was British print discussed coral growth in a manner which was intense and sustained, and transcended class and gender boundaries. Filtering these active discussions through the history of the science of geology documents that the Victorian public engaged with British scientists' framework for coral as evidence of

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[17] Digitization, as Bob Nicholson argued in 2013, offers historians the opportunity to "trace the development and movement of ideas and discursive formations in ways that were once impossible," and in the process to uncover "everyday cultural discourse." Bob Nicholson, "The Digital Turn," *Media History* 19, no. 1 (2013): 63, 66. See also Patrick Leary, "Googling the Victorians," *Journal of Victorian Culture* 10, no. 1 (Spring, 2005): 74, 84, Matthew Kirschenbaum and Sarah Werner, "Digital Scholarship and Digital Studies: The State of the Discipline," *Book History* 17 (2014): 410.

[18] James Secord, *Victorian Sensation: The Extraordinary Publication, Reception, and Secret Authorship of Vestiges of The Natural History of Creation* (Chicago: University of Chicago Press, 2000), 3.

[19] On concept maps, see for example J. D. Novak and A. J. Cañas, "The Theory Underlying Concept Maps and How to Construct and Use Them," Technical Report IHMC Cmap Tools, revised, Florida Institute for Human and Machine Cognition (2008), accessed January 12, 2017, http://cmap.ihmc.us/docs/pdf/TheoryUnderlyingConceptMaps.pdf.

growth in response to environmental change, and applied these insights to interpret accelerating changes in society.

Outline of Chapters

The case studies presented in "Reading Coral in the Age of Darwin" demonstrate the impact of a geological-focus on the British world-view of the evaluation, extraction, and management of this global natural resource. While the overall project proceeds in chronological order, chapters explore nineteenth-century British publications in which authors interpreted of coral growth and engaged with geological theory and method. These geological narratives were conversations among participant-researchers advancing the goal of resource management in the British Empire. The structure of this study owes a debt to Rudwick's analysis of the relationship among members of the Geological Society of London during the 1830s, the period in which this project opens. For Rudwick, the Society's eight hundred members operated under concentric spheres of influence based on individual geologist's capacity to impact the outcome of scientific debates. Rudwick characterized these spheres as a Venn diagram of patterns of authority mapped through participants' correspondence, citations, and references in print.[20] The function of the inner circle, the cohort he termed the élite members, was the interpretation of geological evidence returned from the field by participants occupying the concentric and diminishing spheres of influence, namely, accredited members, amateur geologists, and the general public. In a similar fashion, the three sections of this study analyze, in turn, the communication to the public about the activities of the élite geologists, the

[20] Rudwick, "Charles Darwin in London," 190-194.

dissemination of the work of accredited practitioners collecting scientific data in the field, and finally, the application of geological methodology by periodicals authors. Each of the three sets of authors publishing during the long nineteenth-century addressed the general reader and interpreted evidence of coral growth as geological.

The first section of this project demonstrates that Geological Society of London members used new publication vehicles to bring contemporary coral science to the early nineteenth century general reader. Society members recognized the capacity of these innovative formats to convey élite geologists' illustrated arguments for the historic deposition of fossilized limestone layers and contemporary movement of the layers of the earth's crust to the British public.

Chapter 1, "*Penny Magazine*: Leonard Horner Maps British Coral, 1832-1834," argues that Leonard Horner, a founding member of the Geological Society of London, characterized coral fossils embedded in extensive limestone layers as an indigenous natural resource critical to the maintenance of social order in the early nineteenth-century burgeoning consumer culture. Through Horner's extended series of essays, the newly established *Penny Magazine* led post-Reform Act British readers in an examination of local resources, including coral, which "can hardly have failed to excite feelings of wonder and of no ordinary interest in the minds of those to whom the subject of geology is wholly new."[21] Horner directly addressed penny periodical readers with his extended geological discussion of the impact of coral limestone on British social and economic security.

[21] [Leonard Horner], "Mineral Kingdom. Section 14," Penny *Magazine* 2, no. 98 (Oct. 12, 1833): 394-396.

Charles Darwin's serial woodcut images of the formation of Pacific region coral reefs, published in *On the Structure and Distribution of Coral Reefs* (1842) and reprinted in *Journal of Researches* (1845), portrayed sequential reef growth in response to subsidence over time. Chapter 2, "The Colonial and Home Library: Mr. Darwin and Illustrated Guides to Coral Research" traces the evolution of these images in mid-Victorian geological field guides as evidence of efforts to educate readers on the utility of global field research in interpreting the domestic landscape. Authors Joshua Trimmer, Henry De la Beche, and Thomas Wright, members of the Geological Society of London, adapted Darwin's illustrations of contemporary colonial region coral growth to explain Great Britain's geological history to the general reader. These authors educated the public on how to apply Darwin's accounts of coral activity in Pacific region to confirm the patterns of locally deposited British limestone. Readers visualized coral geology – and British geologists – within a global imperial network.

Using theory to support their first-hand experience that geological forces led to environmental change, the three authors included in the second portion of this study demonstrate the manner in which the Geological Society practitioners of the "new science" encouraged the Victorian reader to conduct independent evaluations of evidence written in global coral deposits. Their narratives document the extension of geological theory and field observations in British domestic regions to more broadly support of imperial resource management in colonial and foreign geographies.

Chapter 3, "The Collected Letters of Sarah Maria Smythe: From the Fijian Reefs to Readers in Belfast, 1858-1864," examines letters written from 1850s through 1860s by a British military officer's wife from pre-annexation Fiji. Smythe incorporated Darwin's

theoretical framework for coral reef growth in response to environment change during the years surrounding the publication of *On the Origin of Species* (1859). This project situates Smythe's dialogue with friends in Belfast at the intersection of her position within a prominent household in Protestant Northern Ireland, her use of geological theory while a female contributor to the Royal Botanic Gardens, Kew-sponsored colonial resource exploration, and her community's self-perception as a partner in English imperial enterprises.

The fourth chapter evaluates the narratives of the Geological Survey's Keeper of Mining Records that described International Exhibition displays of coral branches sourced from colonial and foreign waters. Historians have evaluated catalogue entries on displayed jewelry, but published discussions of the concurrently viewed coral branches have been largely unstudied. "*Hunt's Hand-book*: Coral at London's International Exhibitions, 1851-1862" investigates official, commemorative, and ephemeral exhibition documents in which the relative value of coral was noted as dependent on the geological assessment of the environmental conditions of growth.

Chapter 5, "*Art-Journal*: Peter Lund Simmonds Confronts Geologists, 1860s-1870s," considers the statistician's assessment of British geologists' response to the decline in the Mediterranean coral supply during the second half of the nineteenth century. Peter Lund Simmonds was a curator of post-Crystal Palace exhibition material, recognized by contemporaries for his adept use of statistics in the management of colonial resources. Studied briefly for his work on resource management and recycling efforts, this is the first evaluation of his writings on coral, a raw material he had catalogued post-Exhibition at the South Kensington Museum. Simmonds calculated

British economic interests in the international coral trade, weighting changing tastes and preferences against projected demand for polished coral in colonial regions. Central to his argument claiming British oversight into Mediterranean coral harvesting was his economic interpretation of geological coral growth debates.

The concluding chapter documents the general public's rhetorical engagement with geologists' coral growth arguments during the Victorian era. "*Punch* and the Politics of Victorian Coral Geology," contextualizes the magazine's political cartoon and satirical commentary that revealed the extent to which scientific geological debates impacted nineteenth-century British authors' and readers' coral rhetoric. In vernacular print, coral geology served as a framework with which to explore shifting political issues including the public reaction to Parliamentary proceedings and negotiations concerning Irish home rule. A geological framework of the activities of the coral architect, laboring for the benefit of Britain, infused nineteenth-century Victorian perspectives and attitudes towards this indigenous natural resource.

This project demonstrates the Victorian recognition of the merits of a geological framework in assessing the British interests in the circulation of coral as a global commodity. This study invites a close examination of the interaction of nineteenth-century geologists with the Victorian reader, beyond accounts of significant advances in the field such as the Great Devonian Controversy, in order to reconstruct the geologists' influence in quotidian British narratives largely absent from historical accounts. During the course of the Victorian century, coral geology explained – and justified – British geography. "Reading Coral in the Age of Darwin" establishes a new framework with which to view readers' engagement with coral geological field research to articulate the

emerging foundation of Great Britain during the nineteenth century. Global coral became British coral during the imperial age.

CHAPTER 1

Penny Magazine: Leonard Horner Maps British Coral, 1832-1834

Within months of the inauguration of the early nineteenth century British penny magazines, one reader commented on the abundance of articles on the subject of geology. "I think this clever penny work has come out since you left England," Susan Darwin wrote her brother Charles on March 3, 1833, the day after *Penny Magazine*'s illustrated fourth number of "Mineral Kingdom" arrived at booksellers. Susan celebrated her recent access to "every kind of knowledge written so pleasantly with prints," and shared her news with Charles about the periodicals' publications on this specific topic.[1]

> I think Geology far the most interesting subject one can imagine & now I have found a very easy way of learning a little smattering of it. The penny Magazines give a few pages (which the most foolish person can understand) in every Number on the subject.— [2]

"[W]e all *swear* by" these inexpensive issues, Susan claimed.[3] Accessible articles on this "most interesting" theme – educational in content, brief in length, and published with great frequency – conveyed geologists' research to readers.

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[1] S. E. Darwin to C. R. Darwin, Mar. 3, 1833, DAR 204.6.1, DCP-LETT-200, *Darwin Correspondence Project*, "Letter no. 200," accessed Dec. 26, 2016, http://www.darwinproject.ac.uk/DCP-LETT-200. Emphasis original.

[2] Ibid. Scholars have not commented on Susan's interested in reading about the subject of geology. Jonathan Topham regarded Susan Darwin's letter as evidence penny periodicals readership reached "*haute bourgeois* households." Jonathan R. Topham, "The *Mirror of Literature, Amusement and Instructions* and Cheap Miscellanies in Early Nineteenth-century Britain," in *Science in the Nineteenth-Century Periodical: Reading the Magazine of Nature*, ed. Geoffrey Cantor, et al. (Cambridge: Cambridge University Press, 2004), 39. For Aileen Fyfe, this correspondence demonstrated "readers who could afford more expensive works also bought penny periodicals." Aileen Fyfe, *Science and Salvation: Evangelical Popular Science Publishing in Victorian Britain* (Chicago: University of Chicago Press, 2004), 87.

[3] S. E. Darwin to C. R. Darwin, Mar. 3, 1833.

Clearly, Susan Darwin's enthusiasm for the topic of geology published in this new genre was likely not a typical response among the penny magazines' British readers of both middle- and working-classes, and her conversational tone suggests she shared the content of these articles in the context of her brother's geological field studies prior to his departure on the *Beagle* voyage.[4] Supporting her claim regarding the frequency of this topic in print, however, are digital and archival evidence of geological discussions offered in a number of penny periodical titles during this time period. As Jonathan Topham has demonstrated in his study of the periodicals' inclusion of selections from the *Bridgewater Treatises* series, editors of these new magazines strove to publish "original scientific articles" for the education of post-Reform Act readers.[5] An early issue of *The Saturday Magazine* containing an excerpt from Charles Lyell's recently published *Principles of Geology* (1832), complete with a woodcut reproduction of his "Remains of the Temple of Serapis, at Puzzuoli," serves as an example of innovative geological research conducted by practitioners of this new science, and presented to the public in penny periodicals.[6]

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[4] On Darwin's geological field research, see for example Sandra Herbert, *Charles Darwin, Geologist* (Ithaca, NY: Cornell University Press, 2005), 39.

[5] Jonathan R. Topham, "Science and Popular Education in the 1830s," *The British Journal for the History of Science* 25, no. 4 (Dec., 1992): 410.

[6] "Remains of the Temple of Serapis, at Puzzuoli," in "Some Account of Earthquakes," *The Saturday Magazine* Supplement 2, no. 48 (Mar. 1833): 126. Also "The Boiling Springs of Iceland," *The Saturday Magazine* 1, no. 4 (Jul. 28, 1832): 25-26. "Some Account of the Principal Volcanoes" *The Saturday Magazine* Supplement 2, no. 37 (Jan. 1833): 33-40. Note that the penny magazine articles appeared prior to the publication of Lyell's popular edition of *Principles of Geology*. "The Microscope 1," *The Saturday Magazine* 2, no. 43 (Mar. 2, 1833): 81. "The Microscope 2," *The Saturday Magazine* 2, no. 51 (Apr. 20, 1833): 148-150. "The Coral Islands," *The Saturday Magazine* 3, no. 92 (Dec. 7, 1833): 219. *The Saturday Magazine* included illustrations from William Buckland's "Kirkdale Cave." "Some Account of Natural Caverns and Grottoes," *The Saturday Magazine* 1, no. 42 Supplement (Feb. 1833): 76. Contemporary illustrated geological discussions on coral fossils can also be found in [Anonymous], "Geology I," *The Weekly Visitor* Supplement no. 25 (May 1833): 193-199, [Anonymous], "Geology II," *The Weekly Visitor* Supplement 1 no. 30 (Jun. 1833): 233-240, [Anonymous], "Geology III," *The Weekly Visitor* Supplement 1 no. 40 (Aug. 1833): 313-318.

Significantly, the broadly circulated *Penny Magazine* printed a series of articles authored specifically for Charles Knight's publication. This set of over forty numbers offered original content beyond the extracts from previously published geological volumes. Released in serial format from 1833 through 1835, the unattributed "Mineral Kingdom" essays demonstrated that the periodical functioned as an open forum for the Geological Society of London members' ongoing coral growth debates in two distinct British field research projects undertaken during the early 1830s.[7] The first area of field study involved the investigation of British strata layers to demonstrate the historic formation of fossil-rich strata. Knight published articles presenting arguments about the location of coral limestone strata *concurrent* with Geological Society members' geological debates about the interpretation of fossil evidence recognized by contemporaries as the Devonian controversy.[8] "Mineral Kingdom" thus extended internal discussions on research in the mapping and identification of the composition, deposition, and movement of coral-based fossil strata directly to the public. In addition, *Penny Magazine* published modified woodcut diagrams used during élite Society members' "closed door" discussions.[9] As Martin Rudwick's research on the visual "language" of geologists reminds us, early nineteenth century researchers recognized that

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[7] *Penny Magazine*, *Chambers's Edinburgh Journal* and others continued with the topic of coral into the following decade, publishing Society members' extracts from text authored by Charles Darwin and essays penned by Gideon Algernon Mantell. For Darwin's excerpts, see "Coral Islands - How They are Clothed with Vegetation," *Chambers's Edinburgh Journal* 428 (Apr. 11, 1840): 95-96, "The Lagoon Islands of the Pacific Ocean," *The Penny Magazine* 9, no. 517 (Apr. 25, 1840): 156. For Mantell's writings, see for example [Gideon Algernon Mantell], "More Thoughts 'On a Stone.' (For the London Journal)," *Leigh Hunt's London Journal* 1, no. 14 (Jul. 2, 1834): 110. On the identification of Hunt's publication as a penny periodical, see Leslie A. Marchand, "*Leigh Hunt's London Journal*," *The Journal of the Rutgers University Library* 6, no. 2 (1943): 45, accessed Jan. 3, 2017, http://jrul.libraries.rutgers.edu/index.php/jrul/article/viewFile/1340/2777.

[8] Martin J. S. Rudwick, *The Great Devonian Controversy* (Chicago: University of Chicago Press, 1985). Also James A. Secord, *Controversy in Victorian Geology: The Cambrian-Silurian Dispute* (Princeton: Princeton University Press, 1986).

[9] Rudwick, *The Great Devonian Controversy*, 26. Secord, *Controversy in Victorian* Geology, 16-17.

the interpretation of such sketches required training and consensus.[10] The "Mineral Kingdom" series author instructed readers on how to read cross-section diagrams that geologists themselves used to debate fossil evidence. Annotated woodcut illustrations used in this original series presented Society members' recent explanations for the mounting geological evidence that historic coral activity built the foundation of the British islands.

An additional research area promoted in the pages of *Penny Magazine* was the subject of the mapping of geological coral fossil limestone in the context of British economic resource extraction and management. The series title, "Mineral Kingdom," announced the geological wealth stored in valued commodities including iron, lead, and copper. Yet the opening set of articles on "organic remains" consisted of interwoven essays describing discrete layers of coal and coral – localized sections of the earth's crust containing plant and animal fossil strata – which explained to *Penny Magazine* readers one of British geologists' pressing research themes during the early 1830s. The fifteen articles analyzed in this chapter were published during the first operating months of the newly-formed Geological Survey of Great Britain, and clearly maintained that the Survey project had economic utility for Britain in the identification and mapping of fossil resources.

The identity of the author as Leonard Horner, member of both the Geological Society and the periodical's sponsoring institution the Society for the Diffusion of Useful Knowledge (SDUK), was confirmed decades after publication in the publisher's

[10] Martin J. S. Rudwick, "The Emergence of a Visual Language for Geological Science, 1760-1840," *History of Science* 14 (1976): 166.

autobiography and Horner's own volume of correspondence.[11] Contemporaries recognized Horner's commitment to circulate scientific findings through a range of platforms, including working class education and a vibrant publishing culture within the Society.[12] Yet as economic historian Bernice Martin has documented, Horner was also an early supporter of the movement to establish the Geological Survey.[13] Secord reminds us that the Survey directed its efforts at a specific outcome for its geological mapping, which he argues "can best be understood in the context of a whole series of reform movements in early Victorian society," as geologists aimed to ameliorate the living conditions of all classes through, for example, improved sanitation.[14] This is the first study of a Geological Society of London member's promotion of what Secord categorized as "geology [as] pre-eminently an economically useful activity" placed not in the hands of government officials and politically-engaged classes, but within the

[11] On Leonard Horner as the author of the unattributed series "Mineral Kingdom," see Charles Knight, *Passages of a Working Life During Half a Century: With a Prelude of Early Reminiscences*, vol. 2 (London: Bradbury & Evans, 1864), 318. Martin Rudwick attributed authorship to John Phillips, nephew of William Smith and part-time professor of geology. Martin J. S. Rudwick, *Scenes from Deep Time: Early Pictorial Representations of the Prehistoric World* (Chicago: University of Chicago Press, 1992), 60. Charles Knight's writings credit the series to Horner. Leonard Horner wrote to family that despite increasing demands on his time as Factory Inspector, he planned to continue contributing to *Penny Magazine*, while declining Knight's offer to write for *Cyclopedia*. "I cannot yet tell what leisure I shall have for the *Penny Cyclopedia*. I would gladly continue the articles, but I fear that it might be a burden to be tied down to a particular day, in my circumstances [as factory inspector]. I will certainly go on with *Penny Magazine*." L. Horner to M. Horner, Nov. 29, 1833 in Leonard Horner, *Memoir of Leonard Horner, F.R.S., F.G.S.: Consisting of Letters to His Family and Some of His Friends*, vol. 1, ed. Katharine M. Lyell (Cambridge: Cambridge University Press, 1890, reprint, Cambridge University Press, 2011), 287-288.
[12] "Obituary Notices of Fellows Deceased Between 20th November 1863 and 30th November 1864," *Proceedings of the Royal Society of London* 14 (Jan. 1, 1865): vii-viii. Bernice Martin, "Leonard Horner: A Portrait of an Inspector of Factories," *International Review of Social History* 14, no. 3 (1969): 417.
[13] Martin, "Leonard Horner: A Portrait of an Inspector of Factories," 416. Secord observed that Henry De la Beche was instrumental in establishing the Geological Survey in 1835. James Secord, "The Geological Survey of Great Britain as a Research School, 1839-1855," *History of Science* 24 (1986): 233. This chapter drawn on Knight's autobiography and Martin's biographical sketch. For Horner's service as Factory Inspector, see Patrick N. O'Farrell, *Leonard Horner: Pioneering Reformer* (Heriot Watt University, Edinburgh, 2010).
[14] Secord, "The Geological Survey of Great Britain as a Research School," 224.

illustrated pages of the new genre of penny periodicals.[15] This chapter argues that Leonard Horner's extended discussion in his series "Mineral Kingdom" demonstrated that geologists emphasized Britain's coral geology in the Survey's scheme to contribute to both the management of economic resources and the maintenance of social order during the post-Reform Act decade.

This chapter examines the fifteen articles discussing British geologists' contributions to the understanding of coral "organic remains." Leonard Horner was among the cohort of élite geologists who had recognized from the 1820s the key role illustrations played in explaining not only the location of fossil evidence, but also inferring the age of the deposition of these layers.[16] Horner opened and closed this section of his series in this inexpensive periodical with two full page woodcut illustrations. In the first, the author repurposed a cross-section schematic for the *Penny Magazine* readership to explore "the practical advantages in common life that have been derived" from geological study.[17] Through the information contained in this "Diagram No. 1," the Society member explained that extracted coral limestone displayed architecturally in public and domestic settings – from the Palace of Westminster to the essential mortar used in the construction of common residences – signaled social and economic security for *all* classes during these decades of political flux. The chapter concludes with an evaluation of Horner's closing woodcut addressing post-Reform Act readers that local coral fossil deposits represented what Martin Rudwick has termed the

[15] Secord, "The Geological Survey of Great Britain as a Research School," 233.
[16] Rudwick, "The Emergence of a Visual Language for Geological Science," 166.
[17] [Leonard Horner], "Mineral Kingdom. Section 3," *Penny Magazine* 2, no. 56 (Feb. 16. 1833): 58-59.

"deep history" of Britain.[18] The foundation of the island nation, Horner maintained, was the result of the process of accumulating layers of mineral and fossil economic resources – coal and coral.[19] The author had recently returned from field studies in Europe, and adapted the imagined prehistoric landscape published in his fellow geologist and acquaintance August Goldfuss's *Fossils of Germany*.[20] Horner added cross-references from his own contemporary economics "Mineral Kingdom" narrative to the German illustration to impress on readers an appreciation of the British geologists' valuable contributions to the nation in their execution of both practice and theory, as field researchers conducting "speculative science."[21] *Penny Magazine* clearly connected coral with British geology – and British geologists.

Part 1 – "Stone quarries and Coal Mines": Coral Built the British Nation

> Diagram No. 1. … Limestone with Corals – Neighbourhood of Oxford.[22] Coral … animals have mainly contributed to the formation of many limestone strata, in the same way as we see them now at work forming vast limestone rocks in the coral reefs of the Pacific Ocean.[23]
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> *Penny Magazine*, 1833

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[18] Martin J. S. Rudwick, *Earth's Deep History: How It Was Discovered and Why It Matters* (Chicago: The University of Chicago Press, 2014).
[19] Horner cited the recently published *Principles of Geology*, volume 3 (1833). [Leonard Horner], "Mineral Kingdom. Section 13," *Penny Magazine* 2, no. 97 (Oct. 5, 1833): 387-388.
[20] On Horner's field research in Bonn, see "Obituary Notices of Fellows Deceased Between 20th November 1863 and 30th November 1864," ix. On the dates of Horner's study in Germany, see Martin, "Leonard Horner," 426. Horner considered Goldfuss one of "my learned friends." Leonard Horner, "On the Geology of the Environs of Bonn," *Transactions of the Geological Society of London* Second Series, 4 (1836): 434-435. See also Katharine M. Lyell, in Leonard Horner, *Memoir of Leonard Horner, F.R.S, F.G.S, Consisting of Letters to His Family and From Some of His Friends*, ed. Katharine M. Lyell, vol. 1 (Cambridge: Cambridge University Press, [1890] 2011), 257.
[21] [Horner], "Mineral Kingdom. Section 3," 58-59.
[22] [Leonard Horner], "Mineral Kingdom. Section 2," *Penny Magazine* 2, no. 51 (Jan. 19, 1833): 20.
[23] [Leonard Horner], "Mineral Kingdom. Section 9," *Penny Magazine* 2, no. 76 (Jun. 8, 1833): 221-222.

In one mid-January 1833 number of *Penny Magazine*, publisher Charles Knight issued a promise. "We do not doubt," Knight argued, "that we shall contribute to the instruction and entertainment of many of our readers, by devoting a portion of our Magazine to a series of articles" on the geological nature of British natural resources.[24] Knight, who aimed to extend the goals of the Society for the Diffusion of Useful Knowledge (SDUK) and educate urban workers, had issued in *Penny Magazine* the first eleven discussions of Leonard Horner's extended "Mineral Kingdom" series by the fall of its second year of publication. Knight clearly expressed that his newly-inaugurated Utilitarian-sponsored publication was committing resources and hosting an illustrated geological tutorial. Using a "portion" of multiple issues, Geological Society of London member Leonard Horner crafted a series that functioned as an independent Society resource published for post-Reform Act readers. Linking the science of geology with its social and economic applications, Horner satisfied the SDUK's goal to extend in *Penny Magazine*, as Knight maintained, "useful information to all classes of the community."[25]

The column cross-section illustration labeled "Diagram No. 1" played a central role in Leonard Horner's geological narrative about the ubiquitous fossilized coral limestone layers that formed the foundation of the island of Britain. The left side of the woodcut below, shown here in reproduction in *Knight's Store of Knowledge for All Readers* (1841), explained the composition of the strata, identified and sketched in the field.[26] As Martin Rudwick has demonstrated, British geologists commonly employed

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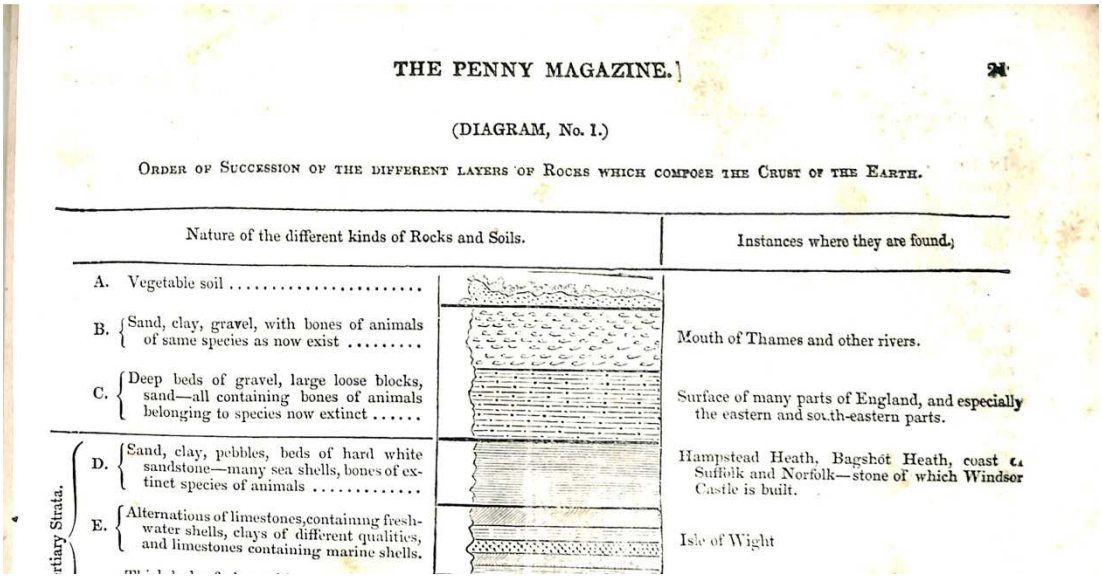
[24] [Leonard Horner], "Mineral Kingdom. Section 1," *Penny Magazine* 2, no. 50 (Jan. 12. 1833): 10-11.
[25] Knight, *Passages of a Working Life*, 317.
[26] [Horner], "Mineral Kingdom, Section 2," 20. Reproduced in [Anonymous], "The Mineral Kingdom," 233-280, in *Knight's Store of Knowledge for All Readers: Being a Collection of Treatises, in Various Departments of Knowledge, by Several Authors* (London, C. Knight [1841]), 235 (detail).

column diagrams which depicted the idealized view of the layers of the earth's crust, as if viewed from a mining shaft.[27]



THE PENNY MAGAZINE.

(DIAGRAM, No. I.)

ORDER OF SUCCESSION OF THE DIFFERENT LAYERS OF ROCKS WHICH COMPOSE THE CRUST OF THE EARTH.

	Nature of the different kinds of Rocks and Soils.	Instances where they are found.
A.	Vegetable soil	
B.	Sand, clay, gravel, with bones of animals of same species as now exist	Mouth of Thames and other rivers.
C.	Deep beds of gravel, large loose blocks, sand—all containing bones of animals belonging to species now extinct	Surface of many parts of England, and especially the eastern and south-eastern parts.
D.	Sand, clay, pebbles, beds of hard white sandstone—many sea shells, bones of extinct species of animals	Hampstead Heath, Bagshot Heath, coast of Suffolk and Norfolk—stone of which Windsor Castle is built.
E.	Alternations of limestones, containing fresh-water shells, clays of different qualities, and limestones containing marine shells.	Isle of Wight

rtiary Strata.

Figure 1.1. "(Diagram No. 1.) – Order of the Succession of the different Layers of Rocks which compose the Crust of the Earth" (detail, column headings). *Source*: *Penny Magazine* 2, no. 51 (Jan. 19, 1833): 21. Image courtesy Drew University Library, Madison, New Jersey

Such diagrams represented geologists' contemporary understanding of the order of layers, or strata, mapped with what Horner regarded as a "considerable degree of precision."[28] The first column of the woodcut also indicated the geologists' consensus on what the author termed "a general description of the nature of the stone."[29] This style of woodcut served as evidence in Geological Society of London debates. The geologist repeatedly referenced this illustrated evidence throughout the first fourteen installments of his "Mineral Kingdom" series in his analysis of indigenous fossil reserves.

[27] Rudwick, "The Emergence of a Visual Language for Geological Science," 169. The following chapter considers the genre of transverse section diagrams that Horner also included in this *Penny Magazine* series.
[28] [Leonard Horner], "Mineral Kingdom. Section 4," *Penny Magazine* 2, no. 59 (Mar. 2, 1833): 86-87.
[29] [Horner], "Mineral Kingdom. Section 2," 19-21.

Diagrams served to represent, reproduce, and document the experiences of the field researcher, yet this schematic representation required practice reading and consensus on interpretation.[30] Rudwick contends that for both men of science and owners of mines such "sections are an aspect of the visual language of geology which is far removed from straightforward observation and which embodies complex visual conventions that have to be learned by practice."[31] Leonard Horner incorporated such conventions in order to clarify for the general audience the geologists' understanding of the geographic location of extracted indigenous resources.[32] He appended a column on the right, tailoring his "Diagram No. 1" for his readers. Horner's title "Instances where they are found" supplied a local filter on geological schematics to indicate the "particular place where that stratum is to be seen."[33] By cross-referencing his series on extracted resources directly to this diagram, the author conveyed his clear aim to represent not only the "manner in which mineral productions are obtained from the interior of the earth," but also engender local ownership of resources in an educational reference guide specifically made "intelligible to the general reader."[34] For Horner's tutorial was not for collectors in the field, but for British consumers reading *Penny Magazine*.

Thus, the year after the passage of the 1832 Reform Act, readers viewed Horner's illustration that simultaneously depicted visible manifestations of these British resources

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[30] As Secord noted, geologists achieved consensus only after "long and acrimonious debates." Secord, *Controversy in Victorian Geology*, 5.
[31] Rudwick, "The Emergence of a Visual Language for Geological Science," 166.
[32] *Penny Magazine* series was not the only periodical to print column diagrams for the penny reader, and a comparison of the two versions demonstrates Horner's intentions. *The Weekly Visitor*, a publication of The Religious Tract Society, included a full-page woodcut image of a conventional geological column diagram. [Anonymous], "Geology I," *The Weekly Visitor* Supplement no. 25 (May 1833): 195. The title of the woodcut in the May, 1833 supplement read simply "Different Kinds of Rocks and Soils," and outlined the primary, secondary and tertiary strata.
[33] [Horner], "Mineral Kingdom. Section 2," 19-21.
[34] [Leonard Horner], "Mineral Kingdom. Section 14," *Penny Magazine* 2, no. 98 (Oct. 12, 1833): 394-396.

and the unseen layers of subterranean coral limestone. When extracted from "stone quarries," the resources served as a source of social and political capital for Britain.[35] In the detail shown below, quarries for coral limestone here designed as strata "I" supplied unique materials for external architecture sourced from specific and unique British regions such as the "Neighbourhood of Oxford."[36]

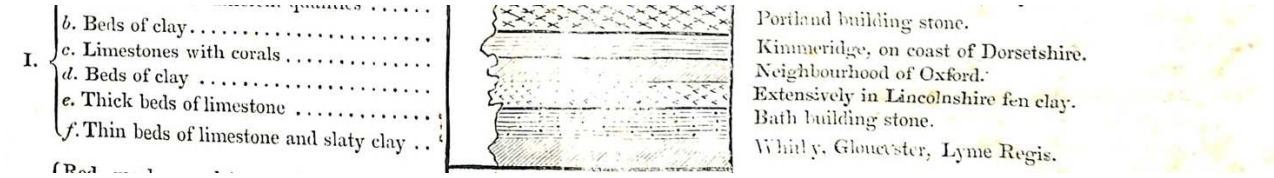

Figure 1.2. "(Diagram No. 1.) – Order of the Succession of the different Layers of Rocks which compose the Crust of the Earth" (detail, "Neighbourhood of Oxford). *Source*: *Penny Magazine* 2, no. 51 (Jan. 19, 1833): 21. Image courtesy Drew University Library, Madison, New Jersey

In addition to identifying the sites of extraction, Horner indicated the locations of England's preeminent structures incorporating these locally sourced materials. Horner's narrative argued that each quarry yielded a distinct product, with the names of specific geographic regions associated with varying aesthetic qualities.[37] He remarked on sources of the "celebrated stones of Bath, Ketton, and Portland, and most of the best building stones of the middle and south of England," used in architectural elements of prominent edifices in locations including Oxford, Cambridge, and London during this time of political reform.[38]

Horner stressed geologists' contributions to the mapping of British strata in the service of the nation were a recent intervention. "It is not more than twenty-one years

[35] Ibid.
[36] [Horner], "Mineral Kingdom. Section 2," 20.
[37] [Leonard Horner], "Mineral Kingdom. Section 6," *Penny Magazine* 2, no. 66 (Apr. 13, 1833): 142-143.
[38] [Horner], "Mineral Kingdom, Section 2," 20. [Horner], "Mineral Kingdom. Section 6," 142-143. On nineteenth-century British architecture incorporating limestone, see for example Gill Hackman, *Stone to Build London: Portland's Legacy* (Bradford on Avon: Folly Books, 2014), chapter 9.

since the great division of the tertiary rocks was established," Horner proudly asserted, yet the practitioners of this "youngest of the sciences" had made significant contributions to knowledge to the location of British coral limestone architectural elements that played an expanding role in expressions of domestic politics.[39] During the early 1830s, buildings which integrated coral limestone in architectural design, as Christine Richardson has maintained, were a public display of the "prestige and power of the British Empire."[40] Incorporated into the construction of buildings including St. Paul's Cathedral and the Palace of Westminster, these materials derived from coral fossil strata served as a visual symbol of political and social stability. Horner's discussion acquired particular significance shortly after publication. A select committee tasked with rebuilding the Westminster following the Great Fire of 1834 stipulated that building materials represent the "medieval origins of the English nation," as historian Michael Alexander has explained.[41] Geologists William Smith and Henry De la Beche led surveys of local limestone quarries and displayed for public inspection samples that best interpreted the political import of the project.[42] *Penny Magazine* articles conveyed how practitioners of geology, for Horner this "youngest of sciences," used their field knowledge of the location of coral limestone in the service of the state.

National identity was not only expressed through the materials used in the exteriors of architecturally-significant public buildings. As geologist, Horner further explained to readers the manner in which Britain's substantial stores of indigenous coral

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[39] [Horner], "Mineral Kingdom. Section 6," 142-143.
[40] Christine Richardson, *Yorkshire Stone to London: To Create the Houses of Parliament* (Sheffield, UK: Richlow, 2007), 9.
[41] Michael Alexander, *Medievalism: The Middle Ages in Modern England* (New Haven: Yale University Press, 2007), 78-79.
[42] Charles Barry and Augustus Pugin selected the Anston quarry. Richardson, *Yorkshire Stone to London*, 9-10.

limestone permitted a degree of national cultural independence from foreign sources of raw materials. Horner outlined the process through which stone quarries yielded domestic, not imported, supplies used in British interior design. Indigenous coral limestone functioned as "excellent marbles for chimney pieces," he observed.[43] While "we must go to Italy for the material for the art of sculpture to be employed upon," Horner detailed in 1833, British artisans crafted local coral limestone material suitable "to all the purposes of ornamental architecture" incorporated within the empire by local laborers.[44]

As an extracted natural resource, coral was also a significant source of limestone fertilizer and building mortar. Coral thus had inherent value as a constituent component of the post-Reform Act British food and housing supplies. Horner reassured readers of the Whig-sponsored periodical as he conveyed geologists' predictions regarding the geographic extent of coral limestone supply based on ongoing field surveys and measurements. "If stones be far-off," Horner asserted, "day is never wanting to supply a substitute."[45] Coral limestone was nearly ubiquitous in Britain, the geologist argued, implying sufficient indigenous supplies to accommodate growing demands for resources. Cultural historian Tony Bennett contends that nineteenth century education employing geological "object lessons" engaged with tangible commodities in a manner consistent with early Victorian drives to "transform the inner lives of the population as to alter their forms of life and behavior," and the larger agenda "of civilizing the population as a

[43] [Horner], "Mineral Kingdom. Section 6," 142-143.
[44] [Horner], "Mineral Kingdom. Section 1," 10-11. Chapter 4 continues this theme in a discussion of the 1851 International Exhibition.
[45] Ibid.

whole."[46] Horner's guide to coral used in public and private architecture, mapped in "Diagram No. 1," offered perspectives on the political and social uses of limestone in a manner which Bennett identified an "instrument of public instruction."[47] In this context, attention to installations of extracted limestone supported readers' understanding of geologists' professional role in identifying resources consumed in the "common business of life" sourced from the "productions of our island."[48]

Finally, undisturbed strata of coral limestone offered specific and critical economic advantages for the nation in early nineteenth-century international trade. Miners used coral limestone *in situ* to identify fossil-based coal deposits.[49] British coal was a natural resource which was "unquestionably," Horner informed *Penny Magazine* readers, "one of the chief sources of our wealth, and of our influence among the other nations of Europe."[50] Referencing his cross-section "Diagram No. 1," the geologist explained that the plant-based coal fossil layer, located in regions such as Newcastle, rested physically above the coral fossil-rich limestone strata.

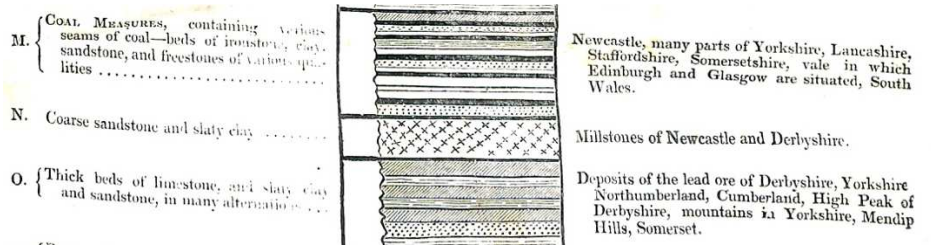

Figure 1.3. "(Diagram No. 1.) – Order of the Succession of the different Layers of Rocks which compose the Crust of the Earth" (detail, "Coal Measures, layer 'M,' Thick beds of limestone, layer 'O'"). *Source*: *Penny Magazine* 2, no. 51 (Jan. 19, 1833): 21. Image courtesy Drew University Library, Madison, New Jersey

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[46] Tony Bennett, *The Birth of the Museum: History, Theory, Politics* (London and New York: Routledge, 1995), 19-20, 28.
[47] Bennett, *The Birth of the Museum*, 28.
[48] [Horner], "Mineral Kingdom. Section 1," 10-11.
[49] [Horner], "Mineral Kingdom. Section 6," 142-143.
[50] [Horner], "Mineral Kingdom. Section 1," 10-11.

While the order of the layers never wavered, in any given location strata may be absent. "The immense practical advantage of this knowledge of the determinate order of succession" was demonstrated in his Diagram, the author informed readers. If coral limestone "were found to occupy the surface of the country, it would be at once known that all search for coal in that spot would be fruitless."[51] While the supply of coal was "almost inexhaustible," British geologists' identification of regional coral fossil strata ensured the efficient mining of valuable coal reserves, a source of national economic and political strength.[52]

Part 2 – Horner's Coda: "Organic Remains Restored"

On October 12, 1833, Leonard Horner summarized his opening series argument that Britain's geological foundation rested on layers of animal and plant fossil remnants. He placed a series index in his article numbered fourteen, concluding his evaluation of "Organic Remains" and illustrations of British geologists' understanding of the composition and thickness of the strata.[53] From the onset, both *Penny Magazine* publisher Charles Knight and the author created an expectation for a completed tutorial, despite its months-long serialization.[54] The geologist published as he wrote, however, and soon recognized that the discussion of fossil layers that opened his series on the "Mineral Kingdom" had increased from its anticipated overall length. As Horner noted in the tenth article in June of 1833, mid-way through his discussion of coral and other

[51] [Horner], "Mineral Kingdom. Section 2," 19-21.
[52] [Horner], "Mineral Kingdom. Section 1," 10-11.
[53] [Horner], "Mineral Kingdom. Section 14," 394-396.
[54] [Horner], "Mineral Kingdom. Section 1," 10-11.

marine fossil remains embedded in British soil, the "introductory matter has grown under our hand beyond what we at first contemplated it would extend to."[55] The author provided this index at the end of this section for his early nineteenth-century readers who desired to review this illustrated unit on the fossil layers of the earth's crust. "Our sections have necessarily appeared at distant intervals, and it will therefore be convenient to such of our readers as wish to go over the subject again with less interruption," he instructed.[56] Embedded in this series was the history and trajectory of British geologists' efforts to map fossil strata locations, from William Smith's explorations during the second decade of the nineteenth-century through current research in the field.

Two weeks after Horner released his index, he offered an additional visual summary of the "organic remains" unit. A front-page woodcut appearing on the fifteenth installment served dual functions: as a coda or finale for his tutorial on British fossil resources, or alternately, as the prelude to a re-reading of the series.

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[55] [Leonard Horner], "Mineral Kingdom. Section 10," *Penny Magazine* 2, no. 79 (Jun. 29, 1833): 244-245. Horner discussed "Organic Remains" in numbers 8 through 14, in issues dated from May through October 1833. [Horner], "Mineral Kingdom. Section 8," 178-179. [Horner], "Mineral Kingdom. Section 14," 394-396. The process of writing sequential articles allowed Horner to incorporate current works, such as references to the third volume of Lyell's *Principles of Geology* as early as May 1833, while assessing Georges Cuvier's work on fish fossils and addressing gaps in botanical fossil research. On Lyell, Cuvier, and Alexandre Brogniart, see [Horner], "Mineral Kingdom. Section 13," 387-388, [Leonard Horner], "Mineral Kingdom. Section 8," *Penny Magazine* 2, no. 71 (May 11, 1833): 178-179, [Leonard Horner], "Mineral Kingdom. Section 12," *Penny Magazine* 2, no. 94 (Sep. 21, 1833): 362-364.

[56] The "preceding Sections have appeared in Nos. 50, 51, 56, 59, 61, 66, 69, 71, 76, 79, 92, 94, and 97. Our sketch has been brief, and may appear to some of our readers very incomplete; but it must be remembered that to have gone into the subject at length would have been inconsistent with the plan of our publication." [Horner], "Mineral Kingdom. Section 14," 394-396.

Figure 1.4. "Organic Remains Restored." *Source*: *Penny Magazine* 2, no. 100 (Oct. 26, 1833): 409. Image courtesy Drew University Library, Madison, New Jersey

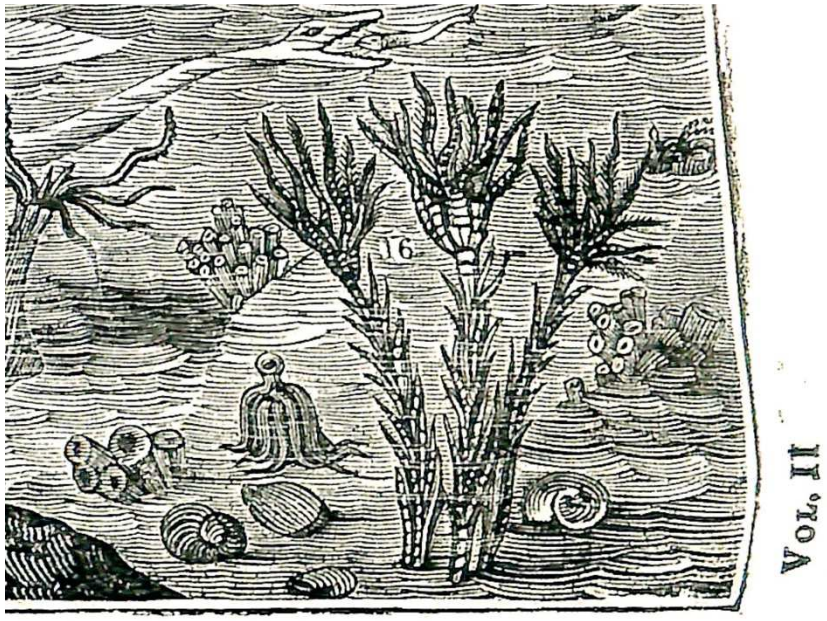

Figure 1.5. "Organic Remains Restored." *Source*: *Penny Magazine* 2, no. 100 (Oct. 26, 1833): 409 (detail. Coral shown left and right, Encrinitis center). Image courtesy Drew University Library, Madison, New Jersey

In October 1833, Horner explicitly connected the numbers on the pre-historic landscape image with the layers of the strata in woodcut "Diagram No. 1."

> Before we entirely leave the subject of Organic Remains, in order to give the reader a clearer idea of the animals and vegetables which characterise the lias and oolitic series of the secondary strata (see diagram No. 1, G to M, page 21), we give a representation of the principal species at present known as restored by some of the most eminent geologists.[57]

Horner proceeded to list these species, linking three elements in his tutorial: the diagram from the second number printed in January, the narrative texts, and the imagined historic landscape published in the fall of 1833.

Rudwick has briefly discussed the appearance of this work in *The Penny Magazine*, observing "[f]or the first time, this moment from the deep past was made vividly real to the general public in Britain."[58] Rudwick argued that the penny periodical image resembled the recent genre used by geologists, including Henry De la Beche and August Goldfuss, depicting the precursor inhabitants of ancient fossil remains in imagined past landscapes.[59] Secord added that De la Beche's *Duria antiquior* (1830) captured an instance in "the history of life, but combined it with a localized picture of ancient coastlines and beaches in particular places in England and Wales."[60]

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[57] [Leonard Horner], "Mineral Kingdom. Section 15," *Penny Magazine* 2, no. 100 (Oct. 26, 1833): 410.
[58] Rudwick, *Scenes from Deep Time*, 60. For a detailed history of this genre of illustration, distributed from 1830 through 1831 as De la Beche's "Duria antiquior" (1830) and "Jura Formation" (1831) in Goldfuss's *Fossils of Germany*, see Rudwick, *Scenes from Deep Time*, 42-54.
[59] Rudwick has argued that Goldfuss based *Jura Formation* on Henry De la Beche's *Duria antiquior*, adding the imagined appearance of both reptiles and invertebrate animals. Rudwick, *Scenes from Deep Time*, 52-53. Rudwick attributed authorship of a "sequence of short articles" to John Phillips, nephew of William Smith and part-time professor of geology. Rudwick, *Scenes from Deep Time*, 60.
[60] Secord, "The Geological Survey of Great Britain as a Research School," 243.

Yet Horner, a Geological Society of London member, modified his version of the woodcut to visualize not a "moment" in time, but the *process* of historical deposition of strata in specific British localities. Indeed, the structure of his "organic remains" series – including the selection and order of topics discussed throughout the first fourteen numbers in *Penny Magazine*, suggests that the author organized his articles with this specific landscape illustration in mind. The inspiration for his image was August Goldfuss's published illustration titled *Jura Formation* (1831). The British penny periodical's composite woodcut inverted the foreground from Goldfuss's image and added illustrations of mid-ground vegetation specifically addressed in *Penny Magazine* numbers published during the preceding months.[61] Again, in a manner similar to his scheme for tailoring geological column diagrams for the general public, Horner modified the image that Rudwick noted was "published in a straightforward scientific work" which was "subscribed to, or at least consulted by, geologists all over Europe."[62] Rudwick had regarded the pre-historic landscape image as "decidedly marginal" to Goldfuss's fossil monograph, as it was "initially regarded as unacceptably conjectural."[63] Yet in Horner's series for the penny reader, the woodcut was not tangential but played a critical role in his economics argument, weaving textual and visual elements into one narrative explaining British resources identified through the efforts of geologists.

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[61] [Horner], "Mineral Kingdom. Section 12," 362-364. Horner retained Goldfuss's foreground species, including an encrinite, despite the fact that he had previously noted that the image of the encrinite "occupies a great extent of country in Germany, but the fossil has never been seen in England, and that kind of limestone is not found in our island." [Horner], "Mineral Kingdom. Section 10," 244-245. His statement suggests his faithfulness to Goldfuss's woodcut, despite its intended portrayal of local British geology in *Penny Magazine*.

[62] Rudwick, *Scenes from Deep Time*, 54.

[63] Rudwick, *Scenes from Deep Time*, 57.

In selecting the title "Organic Remains Restored," moreover, Horner situated his conversation with the post-Reform Act reader in the context of larger Geological Society members' efforts to visualize, or "restore," Britain's past. As William Buckland observed in his discussion of quarries in East Devon, "it requires but little effort, either of the eye or the imagination, to restore and fill up the lost portions of the strata."[64] For Charles Lyell, "by studying the external configuration of the existing land and its inhabitants, we may restore in imagination the appearance of ancient continents which have passed away."[65] It was not just the static appearance of the past landscape that Horner wished to convey to readers, however, but Lyell's argument recently published in *Principles of Geology* which, in Horner's words, explained there is "no condition of the globe inconsistent with the established laws of nature of which we have had experience."[66] Signified by Horner's use of the woodcut title was his argument that extracted indigenous resources – specifically coral – offered readers local explanations for the "ingenious theory" of Lyell. As they interpreted Horner's diagrams, *Penny Magazine* readers encountered regional limestone configurations that explained Lyell's argument that today's geological forces – identical to those in the past, and predicted in the future – continued to produce British resources throughout imperial geography. After all, Lyell, after James Hutton, provided a mechanism with which to account for what in the series "Mineral Kingdom" Horner termed the "most indisputable evidence" of

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[64] William Buckland, *Reliquiae Diluvianae; or, Observations of the Organic Remains Contained in Caves, Fissures, and Diluvial Gravel, and on Other Geological Phenomena, Attesting to the Action of a Universal Deluge*, 2nd ed. (London: John Murray, 1824), 244.
[65] Charles Lyell, *Principles of Geology*, vol 1. (London: John Murray, 1830), 166.
[66] [Horner], "Mineral Kingdom. Section 9," 221-222.

oscillations of the earth, the "many revolutions, during which land and water have repeatedly changed places on the surface" of the globe.[67]

As Horner explained to readers, Lyell's claims regarding oscillation as a past and present geological force explained not only the evidence of coral fossil economic resources found throughout the island of Britain, but also geologists' findings that located coral in discrete strata deposited at different time intervals in abundantly thick layers. In *Penny Magazine*, Horner conveyed the geologists' understanding of the geographic extent and depth of the unseen limestone in repeated references to his Diagram No. 1 in issues released in January, March, April, and June of 1833. "Of all the forms of organized bodies which are found in a fossil state," the Geological Society member proclaimed, "shells and corals constitute by far the greatest proportion," both in "frequency of occurrence" and in "quantity."[68] The author associated the "Organic Remains Restored" image with the layers delineated in the first diagram's geographic notation for the resource-rich regions including Oxford and Newcastle.

The geologist's use of the full-page illustration "Organic Remains Restored" summarized his discussion and pictured the transition over time undergone by "the place now occupied" by specific regions in the island nation, in both the eye and in the imagination. Horner connected the tableau to his economic narrative in a manner which invested the landscape with simultaneous regional variation and local utility. He linked the period in time "before Great Britain rose from out of the deep in its present form" with the preponderance of native fossil resources that positioned the imperial power as

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[67] Ibid. [Horner], "Mineral Kingdom. Section 14," 396.
[68] [Horner], "Mineral Kingdom. Section 9," 221-222. [Leonard Horner], "Mineral Kingdom. Section 5." *Penny Magazine* 2, no. 61 (Mar. 16, 1833): 101-103.

unique, and offered a justification for British exceptionalism grounded in the historic deposition of extractable resources over time.[69]

Discussion – Coral: Window to Britain's Past and Future

Addressing readers for whom geology was "wholly new," Leonard Horner explained that extracted British coral limestone was a prominent fossil-based natural resource. Using clear vocabulary and simply-defined terms, Horner exhorted readers to use "the power of every one who will look a little about him in the ordinary course of life," as the "substance itself must be seen."[70] Visible extracted coral-based resources derived from British quarries – incorporated in national architecture ranging from cathedrals to dwellings of the working-class, adorning interior spaces as aesthetic elements, and functioning as lime fertilizer which increased food supplies, impacted national economic, political, and social capital in the early nineteenth century.

Yet geologists also conveyed the significance of coral not in the visible register. In addition to its utility as commodities, indigenous products were "extraordinary *facts*."[71] Geologists had mapped the location of limestone strata in deep layers in the earth's crust, and Leonard Horner offered this knowledge to readers in his modified cross-section woodcut labeled "Diagram No. 1." Consumers could "cease to guess," Horner instructed, and rather "compare materials," to independently "arrive at some conclusions possessing all the certainty of mathematical demonstration."[72]

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[69] [Horner], "Mineral Kingdom. Section 14," 396.
[70] [Horner], "Mineral Kingdom. Section 2," 19-21.
[71] [Horner], "Mineral Kingdom. Section 14," 394-396. Emphasis added.
[72] [Horner], "Mineral Kingdom. Section 2," 19-21.

For Horner, the conclusions from such evidence were clear: unseen alternating animal and plant fossil layers – coral and coal reserves available for extraction – were indications or signs of Britain's past formation and future economic potential. The varied references to limestone in "Mineral Kingdom," when viewed in aggregate after analyses of digitally scanned issues of *Penny Magazine* from 1833-1834, are remarkable for their measure of the attention shown towards coral as a natural resource by this member of the Geological Society of London. Re-reading the series as Horner intended, replacing what one contemporary author regarded as a first-pass "casual notice" with focused attention derived from "newly-acquired knowledge," two broad themes emerge regarding British geologists' use of coral to leverage these field researchers' impact on the national economy during the years surrounding the formation of the Geological Survey.[73]

The *Penny Magazine* disseminated to readers both local maps and historical imaginings of remnants of coral activity that were economic, political, social, and scientific – and British-based. As a founding member of the Geological Society of London, Leonard Horner conveyed the relevance of ongoing scientific research on this indigenous fossil resource for post-Reform Act readers. Leonard Horner wrote more than forty articles for *Penny Magazine* from 1833 through the fall of 1835.[74] Throughout, the geologist's narrative projected the relevance of the contributions made by emerging field of geology for British society. It is not surprising that Leonard Horner selected the title "Mineral Kingdom" for this extensive series, as this topic had been his primary field of

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[73] James Pycroft, *A Course of English Reading* (London: Longman, 1844), 91–92 quoted in Gowan Dawson, "Paleontology in Parts: Richard Owen, William John Broderip, and the Serialization of Science in Early Victorian Britain," *Isis* 103, no. 4 (Dec. 2012): 654.

[74] Reprinted with modifications in [Anonymous], "The Mineral Kingdom," in *Knight's Store of Knowledge*, 233-280.

study. As Secord has noted, however, the contributions of the several of the founding generation of Geological Society members on the topic "were either unpublished or unintegrated" in geological conversations among the cohort of developing professionals during the 1830s.[75] Indeed, research on minerals by geologists including Horner was "going out of date owing to its relative lack of attention to fossil remains."[76] Horner's articles for public consumption could be interpreted as the geologist's attempt to reassert his sub-field into the emerging political conversations between the Geological Survey members and state agents. It is important to note, moveover, that while the author was not speaking on behalf of the Geological Society of London (f. 1807), he functioned in the *Penny Magazine* series in the role of a chronicler of the history of the science in Britain and wrote from the perspective of one of the Society's earliest members.[77] Horner aimed to represent the current state of the new science to the public, and the field's emphasis on "organic remains" at the onset of the Devonian controversy. The author clearly recognized that the practice of geology was changing rapidly, and the first third of the forty-four articles conveyed practitioners' contemporary research in fossils directly to the general reader.[78]

Horner identified geology as an international field of active research and admitted the contributions of continental geologists on fossils were significant.[79] In his *Penny*

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[75] Secord, *Controversy in Victorian Geology*, 38.
[76] Ibid.
[77] Horner joined the Society in 1808.
[78] Horner's series, published in 1833-1834, preceded works written on fossils for the general public, including Gideon Algernon Mantell's *Thoughts on a Pebble* (1836), *The Wonders of Geology* (1836), and *The Medals of Creation* (1844).
[79] "The great French naturalist Cuvier," studied fossilized fish, "and had he lived much would have been done, for his master-genius threw light on everything he touched." [Horner], "Mineral Kingdom. Section 10," 244-245. Additionally, "very important general results" from obtained from Alexandre Brongniart's studies of fossil botany. [Horner], "Mineral Kingdom. Section 12," 362-364. On Brongniart, see Dawn

Magazine articles educating readers, he focused primarily on the expanding corpus of *British* scientific interpretations of evidence termed "Organic Remains."[80] From his depiction of the formative years under the investigations of field researchers including William Smith, who "gave a new direction to geological inquiries" with his mapping of fossil remains in strata, through his call to readers to interrogate their own home regions, Horner conveyed that by 1833 British geologists had precisely diagramed local strata and confirmed that the order of fossil layers – coal and coral – were nearly "unwavering."[81] Through Horner's efforts, this history of the science in Britain and its current investigations were made accessible to the public.

In his concurrent role as member of the Society for the Diffusion of Useful Knowledge, the geologist conveyed that coral fossil evidence was a reliable indicator of British national strength and social stability for an extended early nineteenth century audience. Horner's series suggests early nineteenth-century geologists viewed the new media of the penny periodical as an effective tool with which to disseminate illustrations used in internal Society discussions to a broader public, including the topic of coral fossil remains. As noted, his goal was to reach those "for whom the subject of geology is wholly new."[82] The geologist identified his target readers in the first number of the series, and addressed those who were familiar with natural resources in the course of their daily lives yet unaware of the process of extraction and the transformation of these

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Mooney Digrius, "Conversations and Contrasting Views: An Examination of the Development of Paleobotany in Nineteenth century Europe, 1804–1895" (Ph.D. diss., Drew University, 2007).

[80] Horner specifically noted British field research in London and the Isle of Wight. [Horner], "Mineral Kingdom. Section 6," 142-143.

[81] [Horner], "Mineral Kingdom. Section 3," 58-59.

[82] [Horner], "Mineral Kingdom. Section 14," 394-396.

minerals into "marketable commodities."[83] In the pages of the *Penny Magazine*, Horner revealed that coral built the foundation of Britain.

The next chapter continues this section's focus on Geological Society of London members and their use of new publishing vehicles to broadly circulate "closed door" discussions about coral geology. Horner had characterized the mass of British limestone in terms of early nineteenth century accounts of coral reef-building activity in the Pacific, in which missionary and navigator narratives reported the dimensions of what was later identified as Australia's Great Barrier Reef.[84] Horner reasoned in *Penny Magazine* that coral "contributed to the formation" of limestone layers in the past, as "we see them now at work" constructing reefs in the Southern hemisphere.[85] For this geologist, distant coral reefs were significant because they visualized the magnitude and extent of British indigenous organic remain economic resources.

In British field guides published during the following decades, authors interpreted Charles Darwin's geological writings on the interchange of water and land as an explanation for the historic deposition of such thick and abundant coral limestone resources in Britain. Darwin's illustrated second edition of *Journal of Researches* (1845) demonstrated for early Victorian-era popular readers how geologists evaluated contemporary coral reef growth to reveal the inevitability of environmental change caused by the movement of the earth's crust. Publishing his revision in John Murray's inexpensive Colonial and Home Library series, he extended his geological argument for

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[83] [Horner], "Mineral Kingdom. Section 1," 10-11.
[84] D. R. Stoddart, "Darwin, Lyell, and the Geological Significance of Coral Reefs," *The British Journal for the History of Science* 9, no. 2 (Jul. 1976): 202-203. Iain McCalman, *The Reef: A Passionate History. The Great Barrier Reef from Captain Cook to Climate Change* (New York: Scientific American/Farrar, Straus and Giroux, 2013). Tom Hiney, *On the Missionary Trail: A Journey Through Polynesia, Asia, and Africa With the London Missionary Society* (New York: Grove Press, 2000).
[85] [Horner], "Mineral Kingdom. Section 9," 221-222.

coral activity to British readers throughout the empire. Darwin's methodology, incorporated in the writings of Charles Kingsley and the pages of geological field guides, depicted the ancient oscillations of their island nation not in terms of imagined landscapes, but through the geology of contemporary coral growth in colonial regions.

CHAPTER 2

The Colonial and Home Library:
Mr. Darwin and Illustrated Guides to Coral Research

> And so arose a puzzle as to how coral rock is often found of vast thickness, which Mr. Darwin explained.
>
> Charles Kingsley, *Town Geology* [1]

For popularizer of science Charles Kingsley, Charles Darwin's geological theory of colonial-region coral reef growth first published in the 1840s clarified his readers' observations of limestone configurations. This chapter opens with the narrative and visual elements of two of Charles Darwin's illustrations in his scientific monograph *The Structure and Distribution of Coral Reefs* (*Coral Reefs*) (1842), subsequently distributed in his popular edition of *Journal of Researches* (1845).[2] Martin Rudwick's analysis of geologists' field diagrams offers a useful framework with which to explore authors' expectations for the public understanding of visual conventions Darwin employed in his text and woodcuts in publications addressing the general reader.[3] Next, the evolution of these woodcut images is traced in British field guides. Darwin did not participate in the construction of "geological column" illustrations, as Sandra Herbert has argued, yet

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[1] Charles Kingsley, *Town Geology* (New York: D. Appleton, 1873), 182.

[2] The second edition of Darwin's "Keeling Island" chapter has not been analyzed in detail. The first edition of this chapter in *Journal of Researches* (Colburn, 1839) has been studied, most recently by Alistair Sponsel. Alistair Sponsel, "Coral Reef Formation and the Science of Earth, Life, and Sea, c. 1770-1952" (PhD diss., Princeton University, 2009), chapter 3. Also, James Secord, "Introduction," in *Charles Darwin. Evolutionary Writings*, ed. James Secord (Oxford: Oxford University Press, 2008), xiii. Literary scholar Nigel Leask has characterized the updated content of the coral chapter as a précis of *Coral Reefs*. Nigel Leask, "Darwin's 'second sun': Alexander von Humboldt and the Genesis of the Voyage of the Beagle," *Literature, Science, Psychoanalysis, 1830-1970: Essays in Honour of Gillian Beer*, ed. Helen Small and Trudi Tate, (Oxford; New York: Oxford University Press, 2003), 35. In contrast, I argue Darwin constructed a new chapter that offered readers not a summary but a tailored discussion of subsidence for his mid-Victorian popular audiences.

[3] Martin J. S. Rudwick, "The Emergence of a Visual Language for Geological Science, 1760-1840," *History of Science* 14 (1976): 149-195.

Geological Society of London members modified his *Coral Reefs* images to convey precisely that set of perspectives, applying colonial to metropole.[4] Finally, Kingsley's application of Darwin's insights for the *Town Geology* working class reader is analyzed in the context of the Geological Society's expanding investigations of coral fossil resources.

In *Town Geology*, Kingsley outlined his simple scheme for teaching local geology during the late 1860s to working-class British men in the English city of Chester, skills he deemed necessary for adult learners during a period of emerging emphasis on formal science education in Victorian Britain.[5] For Kingsley, understanding "the facts of geology," which he identified as recognizing the age of collected fossilized rock and the laws governing their deposition, simply required attentive viewing of bands of material located in recently-exposed regions in the neighboring countryside.[6] As he explained in well-attended lectures, these layers "may be studied in every bank, every grot, every quarry, every railway-cutting."[7] The author argued that the most cursory observations in local regions would reveal to the reader the extent of the exposed coral limestone layers, the source of British building mortar substantial in both height and breadth.

Kingsley explained that geologists had considered the origins of such three-dimensional limestone reserves a "puzzle." For the author, Mr. Darwin's study of the formation of coral reefs in the Pacific region offered a well-regarded solution which,

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[4] Sandra Herbert, *Charles Darwin, Geologist* (Ithaca, NY: Cornell University Press, 2005), 92.
[5] As Kingsley urged the study of natural science, "certainly to all who do not wish their children and their younger brothers to know more about the universe than they do." Kingsley, *Town Geology*, xiv-xv.
[6] Kingsley, *Town Geology*, 3, viii.
[7] Kingsley, *Town Geology*, 3-4. The attendance at classroom lectures, Kingsley wrote to Charles Lyell, was "about sixty." Groups up to one hundred accompanied Kingsley on field trips. C. Kingsley to C. Lyell, Jun. 22, 1871 in Frances Eliza Kingsley, ed., *Charles Kingsley: His Letters and Memories of His Life, Edited by His Wife*., vol. 2. (London: Henry S. King & Co., 1894), 424 and 423-425. Also "Review: Town Geology. By the Rev. Charles Kingsley," *The Spectator* 2319 (Dec. 7, 1872): 1561.

when applied to coral located in the British Isles, accounted for the sheer volume of the product his working-class readers encountered on a daily basis. Over both geological and contemporary time-scales, Kingsley noted, Darwin's subsidence "theory was, and there is no doubt now that it is correct, that in these cases the sea-bottom is sinking; that as it sinks, carrying the coral beds down with it, the coral dies, and a fresh live crop of polypes builds on the top of the houses of their dead ancestors."[8] Continuing, the author questioned readers,

> Thus you find the coral being converted gradually into a limestone rock … Did you never see that last? No? Yes, you have a hundred times. You have but to look at the marbles commonly used about these islands.[9]

"Examine any average limestone quarry from Bristol to Berwick, and you will see there all that I have been describing," Kingsley prompted. There, from south to north, "you will see the corals in every stage" of transformation.[10] In *Town Geology*, Kingsley, the founder of the Chester Society of Natural Science (1871), led working class readers on an educational journey from the "known to the unknown; from a tropic coral island back here to the limestone hills of *these* islands," from the site of Darwin's field research to the coordinates of their own intellectual pursuits in Chester neighborhoods.[11]

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[8] Kingsley, *Town Geology*, 182.
[9] Kingsley, *Town Geology*, 177. Reprinted in Charles Kingsley, "The Lime in the Mortar," *Good Words* (1873): 310.
[10] Kingsley, *Town Geology*, 178. On Kingsley as the founder of the Chester Society of Natural Science (1871) in the context of geotourism, and the function of Kingsley's *Town Geology* as field guide, see Cynthia V. Burek and Thomas A. Hose, "The Role of Local Societies in Early Modern Geotourism: A Case Study of the Chester Society of Natural Science and the Woolhope Naturalists' Field Club," in *Appreciating Physical Landscapes: Three Hundred Years of Geotourism*, 95-116, ed. T. A. Hose (London: The Geological Society, 2016), 97-99. Burek and Hose did not address the thematic chapter structure of Kingsley's book, nor the his discussion of Darwin's theory.
[11] Kingsley, *Town Geology*, 178. Emphasis added. Bernard Lightman addressed Kingsley engagement with Darwin's *Origin of Species*, but not with the popular edition of *Journal of Researches*. Bernard Lightman, *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago: University of Chicago Press, 2007), 78-81. Bernard Lightman, "Darwin and the Popularization of Evolution," *Notes and Records*

As Jonathan Smith reminds us, general audiences encountered Charles Darwin's publications in the context of contemporary events in the public sphere. Smith evaluated a selection of Darwin's mid- to late-nineteenth century volumes, and placed the reception of the author's writings within Victorian "cultural anxieties about class, sexuality, and religion," and "visual conventions of the picturesque and the grotesque."[12] For Smith, Darwin's "works and their illustrations were also tied to the broader visual and aesthetic culture. Darwin's barnacle *Monograph*, for example, appeared amidst the flood of illustrated books on seaside natural history issued from the late 1840s into the 1860s."[13] This chapter situates the circulation of Darwin's illustrated explanation of his coral growth theory in the context of British field guides published during the public immersion in mid-Victorian era geological research.[14] Geological Society of London members Joshua Trimmer, Henry De la Beche, and Thomas Wright applied Darwin's woodcut images theorizing Pacific region coral reef growth to account for the volume of local British limestone strata. Using what Smith has identified as Victorian "visual conventions," field guide book authors tailored Darwin's evidence derived from colonial regions to interpret the geological resources that formed the foundation of Britain, visible

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of the Royal Society of London 64, no. 1 (Mar. 20, 2010): 5-24. See also Piers Hale, "Darwin's Other Bulldog: Charles Kingsley and the Popularisation of Evolution in Victorian England," *Science & Education* 21, no. 7 (2012): 977–1013.

[12] Jonathan Smith, *Charles Darwin and Victorian Visual Culture* (Cambridge: Cambridge University Press, 2006), 24. Smith referenced *A Monograph of the Sub-class Cirripedia* (1851-1854), *The Variation of Animals and Plants under Domestication* (1868), *The Expression of the Emotions in Man and Animals* (1871), and *The Formation of Vegetable Mould, Through the Action of Worms* (1881).

[13] Ibid.

[14] Charles Darwin, *The Structure and Distribution of Coral Reefs. Being the first part of the geology of the voyage of the Beagle, under the command of Capt. Fitzroy, R.N. during the years 1832 to 1836* (London: Smith, Elder and Co., 1842). Charles Darwin, *Journal of Researches into the natural history and geology of the countries visited during the voyage of H.M.S* Beagle *round the world*, 2nd ed., corrected, with additions (London: John Murray, Colonial and Home Library Edition, 1845). On *The Athenaeum* as a source of Geological Society news, see Leslie A. Marchand, *The Athenaeum: A Mirror of Victorian Culture* (Chapel Hill: The University of North Carolina Press, 1941), 53. On penny magazines' promotion of the research of the Geological Society of London members, see Chapter 1.

in their general readers' own field observations of "any average limestone quarry from Bristol to Berwick."[15] As Kingsley argued in *Town Geology*, Society members including Darwin conducted geological research within the British imperial geographic expanse. In chapter titles ranging from "The Coal in the Fire" to "The Lime in the Mortar" the author confirmed for readers of all classes the economic benefits obtained from extracted domestic fossilized plant and animal organic remains.[16]

Local and global coral geology intersected in narratives written for popular audiences describing Darwin's efforts to detect the geological force termed subsidence, or the movement of the earth's crust, during in his field observations of coral animal growth. "If we can understand a little," Kingsley later observed about the layers of British soil, "we shall perhaps be on the right road towards understanding what all England – and, indeed, the crust of this whole planet – is made of; and how its rocks and soils got there."[17] Field guides such as *Town Geology* emphasized the significance of the historic formation of the island of contemporary Britain for the common readers' daily experience and, more broadly, encouraged an appreciation of the empire's share of the potential benefits stored in global geological resources revealed through geological field research. As Leonard Horner had observed in *Penny Magazine*, from a review of Great Britain's reserves of organic remains of coal and coral "it would almost seem, from its internal structure, as if Providence had pre-ordained that it should be the seat of an

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[15] Smith, *Charles Darwin and Victorian Visual Culture*, 24. Kingsley, *Town Geology*, 177-178.
[16] Kingsley included in *Town Geology* historical and current research of the Geological Society of London and the British Geological Survey. In addition to Darwin, Kingsley introduced Charles Lyell, Henry De la Beche, Charles Eugene De Rance, Archibald Geike, Joshua Trimmer, Andrew Crombie Ramsay, and Wyville Thomson to readers in his chapter titled "The Pebbles in the Street." Kingsley, *Town Geology*, 36-80. Kingsley, *Town Geology*, "Table of Contents."
[17] Kingsley, *Town Geology*, 17-18.

opulent and powerful people."[18] Writing nearly four decades later, Kingsley conveyed the magnitude of these indigenous resources extracted from British mines and quarries.

> Thousands of feet of rich coral reef; thousands of feet of barren sands; then thousands of feet of rich alluvial forest; — and all these sliding into each other, if not in one place, then in another, without violent break or change: this is the story which the lime in the mortar and the coal on the fire— between the two — reveal.[19]

Pairing Darwin's research in colonial regions with Geological Society of London members' investigations into domestic limestone configurations, field guide authors explored with readers – including communities residing in the English city of Chester – a world-view of the wealth of coral centered in the British islands.

Part 1 – Darwin's Drawings

Since the first decades of the nineteenth century, geologists relied on illustrations to document and defend arguments based on evidence acquired during field work, and as Sandra Herbert has observed, Charles Darwin was no exception to this practice.[20] Darwin addressed the professional membership of the Geological Society of London in May 1837 shortly after his return to England following service as naturalist onboard the HMS *Beagle*.[21] Illustrations were central to his goal to convince peers that coral reefs were appropriate sites for geological research. Darwin's drawings, Alistair Sponsel

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[18] [Leonard Horner], "Mineral Kingdom. Section 1," *Penny Magazine* 2, no. 50 (Jan. 12, 1833): 10-11.
[19] Kingsley, *Town Geology*, 188.
[20] Herbert, *Charles Darwin, Geologist*, 92. On the history of geological diagrams, see, for example, Rudwick, "The Emergence of a Visual Language for Geological Science," 158.
[21] Sponsel, "Coral Reef Formation," chapter 3. See also M. J. S. Rudwick, "Charles Darwin in London: The Integration of Public and Private Sphere," *Isis* 73, no. 2 (1982): 186-206.

noted, remained on display at Somerset House for a period of time after his 1837 address.[22] By 1835, tenants at Somerset House included the Royal Society, Antiquaries, and Astronomical Society in addition to the Geological Society, suggesting a wide audience for Darwin's illustrated arguments among a cohort of learned gentlemen.[23]

While the diagrams from his 1837 Geological Society session have not been located, the government-financed *Narrative of the Surveying Voyages of His Majesty's Ships Adventure and Beagle* (later re-released in 1839 as *Journal of Researches*) preserved his narrative "sketch" in the form of a textual argument detailing the dual exploratory missions.[24] Darwin recognized the constraints placed on readers of this geological argument in the absence of illustrations. For example, in the first edition of *Journal of Researches* (1839) Darwin outlined his conjecture that the distance between the coral reef ring and the enclosed island was proportional to the amount of the downward movement of the ocean floor. "Without the aid of sections," he wrote apologetically for purchasers of the expensive multi-volume set, "it is not very easy to follow out the result, but a little reflection will show" that the width of the lagoon paralleled the degree of subsidence.[25] As scholars have explored in detail, *The Structure and Distribution of Coral Reefs* (1842) addressed this short-coming and incorporated a

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[22] Sponsel, "Coral Reef Formation," 182.
[23] "Literary and Scientific Intelligence," *The Gentleman's Magazine* 157 (Jan. 1835): 77.
[24] Charles Darwin, *Narrative of the Surveying Voyages of His Majesty's Ships Adventure and Beagle Between the Years 1826 and 1836, Describing their Examination of the Southern Shores of South America, and the* Beagle's *Circumnavigation of the Globe, in three volumes*, vol. 3 (London: Henry Colburn, 1839). Charles Darwin, *Journal of Researches into the geology and natural history of the various countries visited by H.M.S. Beagle* (London: Henry Colburn, 1839), 554. On the inclusion of the address, D. R. Stoddart, "Darwin, Lyell, and the Geoglogical Significance of Coral Reefs," *The British Journal for the History of Science* 9, no. 2 (Jul. 1976): 206, 216 note 73.
[25] Darwin, *Journal of Researches* (1839), 559. Emphasis added.

number of illustrations in support of the author's argument for subsidence.[26] Darwin's first monograph provided the geologist an opportunity to include cross section depictions of the process of coral reef growth in response to subsidence, in addition to supporting sounding charts, distribution maps, and landscape views of reefs under development. More broadly, Darwin used drawings in *Coral Reefs* to support his argument that "the study of coral-formations, originally attempted merely to explain their peculiar forms," under the scientific discipline that Sponsel has identified as the zoology of coral activity, "may be thought worthy of the attention of geologists."[27]

In 1845, however, Darwin explicitly extended his theory to the "general reader" as well as the naturalist.[28] He included five woodcuts from *Coral Reefs* in the "Keeling Island" chapter in the second edition of *Journal of Researches*, published in John Murray's inexpensive and widely circulated Colonial and Home Library edition.[29] Darwin conveyed in illustrations directed towards both sets of readers, armchair travelers as well as men of science, that active contemporary coral growth resulting in the construction of reefs was in fact a response to specific and measurable geological forces.[30] It is significant that Darwin did not offer a detailed explain of *how* to interpret

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[26] Darwin, *Coral Reefs*, 148. For an extensive discussion of Darwin's scientific arguments in these texts, see Sponsel, "Coral Reef Formation," 243 and chapter 3. For an analysis of the *Coral Reefs* woodcuts through the lens of visual culture studies, see Alan G. Gross and Joseph E. Harmon, "Visual Argument and Narrative in the 'Historical' Sciences: The Example of Geology," in *Science from Sight to Insight: How Scientists Illustrate Meaning* (Chicago and London: University of Chicago Press, 2014), chapter 5.
[27] Darwin, *Coral Reefs*, 148. Sponsel, "Coral Reef Formation," 243-244.
[28] Darwin, *Journal of Researches* (1845), v.
[29] As in the first edition, Darwin's diary entries supplied the foundation for the opening narratives in the revised "Keeling Island" chapter. Secord, "Introduction," xiii. The second section of the revised coral reef chapter replaced, as the author noted, the text "first read before the Geological Society in May, 1837," with an illustrated argument that had "since been developed in a separate volume on the 'Structure and Distribution of Coral Reefs'." Darwin, *Journal of Researches* (1845), note on 465.
[30] For Pieter François, "real travelers" sought "inspiration," while home readers looked for "entertainment." Pieter François, "If it's 1815, This Must be Belgium: The Origins of the Modern Travel Guide," *Book History* 15 (2012): 82.

his geological cross section diagrams for his second edition audience in 1845. Martin Rudwick's scholarship on the visualization of early Victorian-era geological arguments places these *Journal of Researches* woodcuts and narratives addressing the popular reader in context. In "The Emergence of a Visual Language for Geological Science," Rudwick has noted that transverse sections, the visual "equivalent of a line of natural coastal cliffs," by the 1830s were "understood widely enough to be used increasingly in the form of wood engravings to illustrate popular books on geology."[31] In addition, as the previous chapter has documented, British household readers including Darwin's family member Susan had access to a second style of visualization, that of the column section woodcut depicting subterranean layers of rock in penny periodicals published during the same decade.[32] Darwin's scheme suggests that he recognized that John Murray's readers were likely familiar with reading diagrams depicting both surface landscape and columnar mining views of geological structures.

Charles Darwin did, however, teach his readers how to compare geological cross-section woodcut images *sequentially*, explaining what Alan G. Gross and Joseph E. Harmon have identified in their study of *Coral Reefs* as "a dynamic model of reef-island evolution over geological time."[33] Focusing on one pair of cross-section woodcut

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[31] Rudwick, "The Emergence of a Visual Language for Geological Science, 1760-1840," 171. Recall from the previous chapter, Leonard Horner had modified Geological Society images later termed stratigraphy to visualize the unseen extent of the sources of extracted minerals and organic fossil strata.

[32] [Leonard Horner], "Mineral Kingdom, Section 2," *Penny Magazine* 2, no. 51 (Jan. 19, 1833): 20. Also [Anonymous], "Geology I," *The Weekly Visitor* Supplement no. 25 (May 1833): 195.

[33] Gross and Harmon, "Visual Argument and Narrative in the 'Historical' Sciences," 173. In this regard, Darwin repeated a visual strategy used in a previous chapter in *Journal of Researches* (1845). Julia Voss has discussed the impact of the serial arrangement of his Galápagos finch woodcut illustrations commissioned for the 1845 edition which clearly showed "gradual modification." Voss did not, however, discuss the "Keeling Island" chapter woodcuts. Julia Voss, *Darwin's Pictures: Views of Evolutionary Theory, 1837-1874*, trans. Lori Lantz (New Haven: Yale University Press, 2010), 56. I thank David Kohn for bringing Voss's work to my attention.

illustrations Darwin used in both his popular and scientific volumes demonstrates how the author narrated geological *motion* for the general audience. He merged perspectives drawn from conventional transverse and cross-section diagrams to simultaneously show land masses above and below the surface of the ocean.

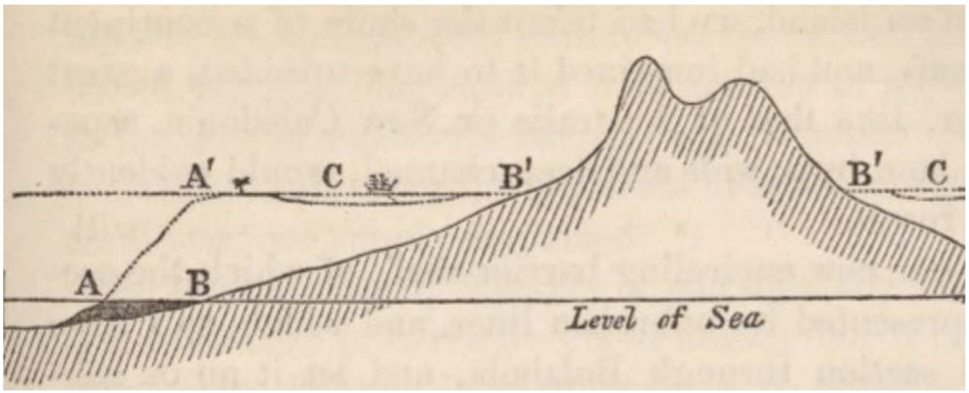

Figure 2.1. Fringing-reefs. *Source*: Charles Darwin, *Journal of Researches* (1845), 473 (detail).

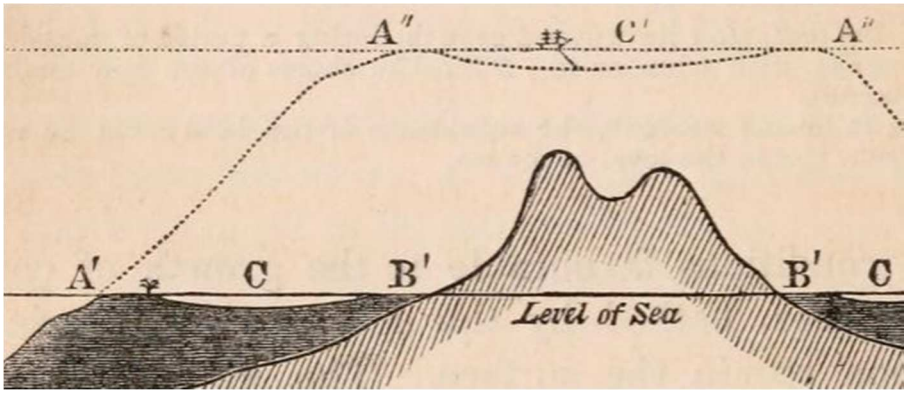

Figure 2.2. Barrier-reef. *Source*: Darwin, *Journal of Researches* (1845), 474 (detail).

Darwin's narrative directed readers' attention to a cycle of interacting forces that he and others had observed in the field: the "insensibly" sinking island, "living masses" of coral which "soon regain the surface," and ocean water "encroaching" on the "proportionally broader" shores.[34] Setting the stage with these rhetorical strategies, Darwin's tutorial

[34] Darwin, *Journal of Researches* (1845), 473.

placed the drama in motion, asserting that the drawing shown above on the left represents action *in medias res*: "section of the reef and island in this state, after a subsidence of several hundred feet, is given by the dotted lines."[35] Darwin urged readers to visualize the process through which "this island with its reef, represented by broken lines in the woodcut, slowly subside[d]."[36] He situated a horizontal line marked "Level of the Sea" in this first diagram, denoted "A." In the subsequent image, shown above right, he changed the position of this marker indicating the surface of the ocean to a position labeled "A prime."[37] "In this and the following woodcut," Darwin noted, "the subsidence of the land could be represented only by an apparent rise in the level of the sea."[38]

Smith has explored Darwin's navigations through the challenging task of using two-dimensional sketches to conceptualizing change over time for his readers of his subsequent publication *On the Origin of Species* (1859). Regarding *Origin*, Smith observed that "Darwin faced a major illustrative difficulty: how was natural selection to be depicted *visually*? How could something that acts at such a leisurely pace on such tiny variations be captured directly?"[39] As Smith explained, "natural selection was not a phenomenon, and event, or a thing, but a *process*. Darwin was asking his readers to visualize how one scene modified into another via a mechanism that, unlike geological forces, could not be directly observed in the present."[40] Clearly, violent geological disturbances including earthquakes and volcanic eruptions captured the attention of

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[35] Ibid.
[36] Darwin, *Journal of Researches* (1845), 472-473.
[37] In the popular edition in John Murray's Colonial and Home Library series, the woodcuts were placed on facing pages, facilitating a direct comparison. In *Coral Reefs*, the images appeared on consecutive pages.
[38] Darwin, *Journal of Researches* (1845), 473. Also, Darwin, *Coral Reefs*, 98.
[39] Smith, *Charles Darwin and Victorian Visual Culture*, 9. Emphasis original.
[40] Smith, *Charles Darwin and Victorian Visual Culture*, 10. Smith offered that these challenges could explain the "paucity of illustrations in the *Origin*." Smith, *Charles Darwin and Victorian Visual Culture*, 9.

Society members including Lyell and Roderick Murchison and editors of periodicals alike.[41] Yet in *Coral Reefs*, and later in the Colonial and Home Library edition of *Journal of Researches*, Darwin endeavored to lead his readers to "safely infer" the process of subsidence, an underwater geological force that could not be directly observed yet clearly conveyed in this series of illustrations.[42]

Darwin further argued that his theory of subsidence illustrated through the serial woodcut drawings "simply explained" the "leading features" of the three types of coral structures observed in these colonial waters, and "which have for so long excited the attention of voyagers."[43] He urged his readers to investigate a geological process not readily visible – subsidence of the ocean floor – as the precise force, operating over time, which explained navigator and missionary accounts of reef geography, incorporating what Sponsel has characterized as "Western attitudes towards coral reefs."[44] As Darwin maintained in the popular edition of *Journal of Researches*, his innovative exploration of the submarine foundations of structures superseded British voyagers' geographic evaluation of surface reef landscape with one rooted in the current focus of the science of geology, that of uniform forces operating in the past and consistent with those impacting contemporary coral growth patterns.

Part 2 – Guides for Coral Field Work

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[41] See, for example, "Some Account of the Principal Volcanoes" *The Saturday Magazine* Supplement 2, no. 37 (Jan. 1833): 33-40. "Some Account of Earthquakes," *The Saturday Magazine* Supplement 2, no. 48 (Mar. 1833): 121-128. Herbert, *Charles Darwin, Geologist*, 88-89.
[42] Darwin, *Journal of Researches* (1845), 473.
[43] Darwin, *Journal of Researches* (1845), 475.
[44] Alistair Sponsel, "From Cook to Cousteau: The Many Lives of Coral Reefs," in *Fluid Frontiers: Exploring Oceans, Islands, and Coastal Environments*, ed. John Gillis and Franziska Torma, (Cambridge, UK: White Horse Press, 2015), 139.

Darwin's published colonial field research, together with Leonard Horner and other fellow Geological Society members' reports of coral fossils studies conducted throughout the globe, demonstrated in texts accessible for the general public the new directions taken by practitioners as they interpreted indications of geological forces over time. Contemporaries noted mid-Victorian era readers were exposed to multiple conversations about geology. In his presidential address to Geological Society of London members in 1840, the influential *Bridgewater Treatises* author Rev. William Buckland had "noted the spread of geology into all areas of public life."[45] Regarding the topic of coral growth, Darwin's theory reached a generation of popular readers for whom, observed Simon Knell, "geology had been normalized as a subject," in the process of being actively integrated into "local networks and collections."[46] The author's "Keeling Island" chapter in the John Murray popular edition of *Journal of Researches* circulated broadly in a format which, Secord noted, was "afforded by professional families, merchants, and working-class libraries."[47] Society members including Charles Lyell and Gideon Mantell, as will be discussed in Chapter 4, continued to recommend Darwin's scientific monograph *Coral Reefs* as reading material suitable for these general audiences.[48]

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[45] *Geology and Mineralogy Considered with Reference to Natural Theology* (1837). William Buckland, *Proceedings of the Geological Society of London* 3 (1840): 210-267 cited in Simon Knell, "The Road to Smith: How the Geological Society Came to Possess English Geology," in *The Making of the Geological Society of London*, eds. C. L. E. Lewis and S. J. Knell, (Bath, UK: The Geological Society Publishing House, 2009): 42.

[46] Knell, "The Road to Smith," 42.

[47] James Secord, "Introduction," xiv. On Murray's Colonial and Home Library series, see Angus Fraser, "John Murray's Colonial and Home Library," *Papers of the Bibliographical Society of America* 91, no. 3 (1997): 346. I thank David McClay, Archivist at The John Murray Archives, for directing me to Fraser's comprehensive resource. On *Beagle* Captain Robert FitzRoy's account of the residents of Keeling Island, see Robert L. Wesson, *Darwin's First Theory: Exploring Darwin's Quest to Find a Theory of the Earth* (New York: Pegasus Books, 2017), 180-181.

[48] Charles Lyell cross-referenced both editions of *Journal of Researches* with *Coral Reefs*. Charles Lyell, *Principles of Geology*, 7th ed., (London: John Murray, 1847), 751, 758. Gideon Algernon Mantell, *The*

Geologists who participated in the circulation of Darwin's coral growth argument viewed his theory, explained Lyell, as a "new opinion which must, at first sight, seem paradoxical in the extreme."[49] For as Lyell maintained, Darwin theorized that Pacific Ocean coral reef structures termed atolls were located "precisely in the place once occupied by the highest part of a mountainous island."[50] Pacific colonial landscapes known to the British public through the tales of missionaries and navigators were not expanding due to the deposition of "fresh rocks and reefs which are continually rising to the surface," rather represented a state of transition due to contemporary geological forces.[51]

British field guides authors immediately applied both the theoretical and practical aspects of Darwin's geological study of present-day coral growth to explore the historic deposition over time of indigenous coral limestone strata configurations in their readers' home regions. Darwin's accessible and clearly communicated theory of coral growth offered members of the Geological Society of London a framework through which Victorians, engaging in both instructor-led groups and solitary explorations of the British exposed countryside, interpreted limestone layers with "geological hammer in hand."[52] This is not to claim that all mid-century field guides introduced Darwin's writings and illustrations about coral geology to their readers. The three authors under consideration

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Wonders of Geology, or, A Familiar Exposition of Geological Phenomena, 6th ed., vol. 2 (London: Henry G. Bohn, 1848), note on 632, note on 484. Mantell explained Darwin's coral theory to the public *before* John Murray released the final installment of Darwin's second edition of *Journal of Researches* in August 1845. See Charles Darwin, *Journal of Researches* (1839), 547 quoted in [Gideon] M[antell], "Coral Islands. No. II," *The Visitor, Or, Monthly Instructor* (Apr., 1845): 158. Also [Gideon] M[antell], "Coral Islands. No. IV," *The Visitor, Or, Monthly Instructor* (Jun., 1845): 208.

[49] Lyell, *Principles of Geology* (1847), 755.

[50] Ibid.

[51] "The Coral Islands," *The Saturday Magazine* 3, no. 92 (Dec. 7, 1833): 219, 221. See also Anon, "The Coral Insect," *Wesleyan-Methodist Magazine* (1824): 466. Anon, "Review: *Corallina*," 533.

[52] F. E. Kingsley, ed., *Charles Kingsley: His Letters and Memories of His Life,* 424.

here, however, clearly stressed the importance of local applications of Darwin's Pacific region observations for both students of geology and members of amateur clubs, in books designed to be carried into the field "from Bristol to Berwick."[53]

First, Geological Society of London member Joshua Trimmer instructed those for whom supervised viewing was not feasible, readers located in "remote parts of the country," in a manner which demonstrated the impact of Darwin's methodology on practitioners of the science.[54] For Trimmer, geology had been "eminently a social science," in which its adherents, "acting in concert," had made significant advances in the ability to identify and date evidence found in the field.[55] In his 1841 volume *Practical Geology and Mineralogy*, Joshua Trimmer asked "what are those readers to do – and they are numerous," who labor in solitude and reside in regions where geology teachers remain "inaccessible?"[56] Trimmer's work offered Victorian era individuals with limited access to mentors and personal guides, and living far from "arranged cabinets" in museums, a volume that in his opinion was primarily a "purely geological work" which offered "facts and classification" in the "practical value of geology."[57] The title of Trimmer's work, *Practical Geology and Mineralogy; With Instructions for the Qualitative Analysis of Minerals* (1841), recalled the Geological Society of London's

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[53] Kingsley, *Town Geology*, 177-178. For Thomas A. Hose, "the poor condition of many non-library copies" likely demonstrates that British geology field books were "cheap enough to be taken into the field." Thomas A. Hose, "Geoheritage in the Field," in *Geoheritage and Geotourism: A European Perspective*, ed. Thomas A. Hose (Woodbridge, UK: The Boydell Press, The International Centre for Cultural & Heritage Studies, Newcastle University, 2016), 117.
[54] Joshua Trimmer, *Practical Geology and Mineralogy; With Instructions for the Qualitative Analysis of Minerals* (London: J. W. Parker, 1841), iv.
[55] Trimmer, *Practical Geology*, 2.
[56] Trimmer, *Practical Geology*, iv.
[57] Trimmer, *Practical Geology*, v.

founding mission to demonstrate the location of Britain's mineral deposits and enhance their extraction.[58]

Yet Trimmer found equal value in offering new students of geology studying independently access to the theoretical aspects of the science, or what he termed the "higher generalizations."[59] In 1836, Trimmer had previously published his opening chapters in essay form in the short-lived periodical *The Magazine of Popular Science, and Journal of the Useful Arts*.[60] His subsequent book, released in 1841, included Darwin's work in a manner which revealed the geologists' engagement with public texts as an open forum for debates about both the interpretation of physical evidence and scientific theory generated through global coral research. In 1838, two years after the publication of Trimmer's articles, Whewell had remarked in his address to the Geological Society of London members that Darwin's "history of coral isles" clearly articulated "the causes of change by which geological phenomena have been produced."[61] For Sponsel, Whewell used the opportunity to highlight coral research as exemplifying changes in the discipline itself.[62] As Whewell argued before élite geologists, with Darwin's field studies

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[58] On the founding mission of the Geological Society in practical geology, see for example Leucha Veneer, "Practical Geology and the Early Geological Society," in *The Making of the Geological Society of London*, eds. C. L. E. Lewis and S. J. Knell, (Bath, UK: The Geological Society Publishing House, 2009): 243.
[59] Trimmer, *Practical Geology*, v. Trimmer called likewise for miners' education, consistent with the Society's social reform measures discussed in Chapter 1, but additionally to further develop the theoretical aspects of the field of geology, arguing "In the depths of the mine … those hidden laws of nature which they are investigating, are daily passing unnoticed before the eyes of working miners. … [S]cientific knowledge as will be useful to them in their vocation [because] these phenomena will arrest their attention, and though they may not themselves be capable of generalizing from them, they will not fail to bring them under the notice of those who have the ability to do so." Trimmer, *Practical Geology*, 21, note on 21.
[60] Trimmer, *Practical Geology*, iii. Trimmer noted that he had published the first part of his narrative in a series in periodical. See "A Popular Course in Geology," *The Magazine of Popular Science, and Journal of the Useful Arts* 2 (1836) 1-11. Compare "A Popular Course in Geology," 9 with Trimmer, *Practical Geology*, 11. See also "A Popular Course in Geology II. Practical Applications of Geology," *The Magazine of Popular Science, and Journal of the Useful Arts* 2 (1836): 223-235.
[61] William Whewell, "Address to the Geological Society," *The Edinburgh New Philosophical Journal* (Apr.-Oct., 1838): 158.
[62] Sponsel noted that in this address, Whewell, as "the chronicler of the practice of science itself," clearly situated Darwin's efforts within history of geology. Sponsel, "Coral Reef Formation," 185. Darwin had

in the Pacific region "we pass from mere descriptive geology, to that other division of the subject which I have termed Geological Dynamics."[63] The future of geology, Whewell contended, was in the study of geological motion. Yet as Trimmer confessed in his preface, he remained unconvinced that his discipline's future rested entirely in a realm devoid of the principles of strata mapping espoused by the field's founding members. Trimmer, who joined the Society in 1832, recognized instead a "gradation by which descriptive geology passes into geological dynamism."[64] For Trimmer, Darwin's coral research represented a continuum in methodology and not a break from prior practices, as it disclosed the earth's movement while offering readers valuable applications in their own investigations of British landscapes. Coral limestone mapping in adjacent geographic regions throughout the island nation disclosed geological change over time explained by Darwin's theory. As Trimmer advised his readers,

> The gradual elevation and depression of the bed of the ocean in alternate bands during ancient geological epochs, analogous to that which appears from Mr. Darwin's observations to be now in progress in the Pacific, may be offered as an explanation of that alternation of developement [*sic*] in the rocks of contiguous systems, within the distance of a few hundred miles, of which the British Islands afford many examples.[65]

Extending Darwin's research, Trimmer reasoned that contemporary coral growth in response to oscillation, not just subsidence, provided guidelines for constructing

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sent a Whewell a draft copy of his "Keeling Island" chapter prior to the February 1838 address. Sponsel, "Coral Reef Formation," 182.

[63] Whewell, "Address to the Geological Society," 157-158.

[64] Trimmer, *Practical Geology*, v. On Trimmer's membership in London Geological Society, see *The Dictionary of National Biography* (1921) s.v. "Joshua Trimmer."

[65] Trimmer, *Practical Geology*, 445.

descriptive maps of historic limestone deposition. Readers in remote regions, far from museum specimens and what he termed "oral instructions," could apply colonial-region Society research to account for "the thickness of the gneiss in Scotland," subsequent thinning of the strata in Cumberland, and transitions between strata thickness observed in North Wales compared with the "English border."[66]

Published the year *prior* to *Coral Reefs*, the illustrated *Practical Geology and Mineralogy* remains an early an appropriation of Darwin's visualized theory of coral growth in domestic settings. More broadly, Trimmer's woodcuts disclosed the reverberations of Darwin's theory within the Society members and captured their awareness of shifts in the focus of their field. Trimmer's work demonstrates his immediate recognition of the utility of Darwin's drawings for their practical application in the training of English geologists. Trimmer's own images in 1841 documented the volume of submarine coral deposits, what Darwin subsequently referred to in the Colonial and Home Library edition of *Journal of Researches* as the "great wall-like mass" built by "little architects."[67]

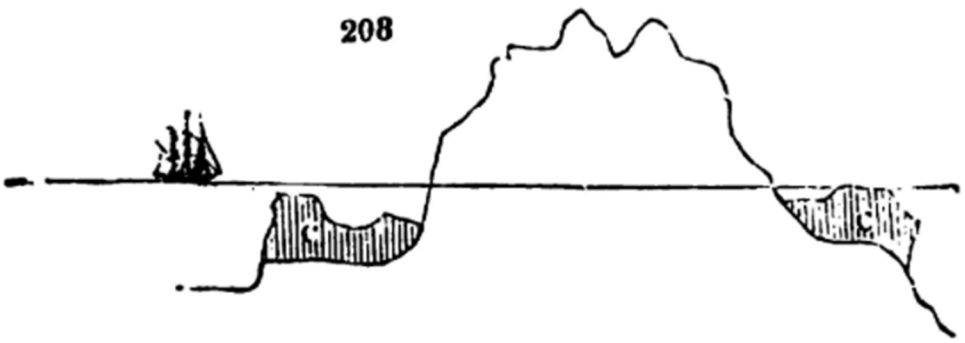

Figure 2.3. "High island, surrounded by an investing reef of coral." *Source*: *Practical Geology and Mineralogy* (1841), 443 (detail).

[66] Ibid. Trimmer, *Practical Geology*, iii.
[67] Darwin, *Journal of Researches* (1845), 473.

In Trimmer's rendition, shown above, sequential soundings calculated the extent of this "mass" of coral as measured from the deck of the sailing vessel approaching the fringing reefs, shown above.[68] In the illustration below depicting the vessel anchored in a lagoon channel, stratigraphic markings in cross-sections emphasized the resulting coral volume.

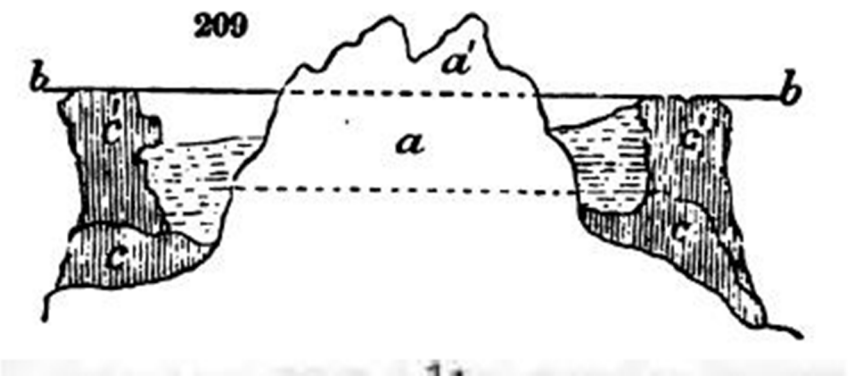

Figure 2.4. Joshua Trimmer, "[A]s the land slowly subsides."
Source: *Practical Geology and Mineralogy* (1841), 444 (detail).

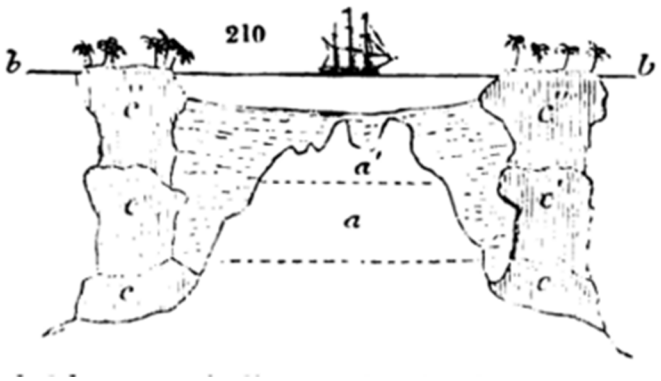

Figure 2.5. Joshua Trimmer, "As the subsidence continues."
Source: *Practical Geology and Mineralogy* (1841), 444 (detail).

[68] Trimmer included this image of authentically-rendered British ships in the conduct of geological field work in the Indian Ocean. Richard Milner has recently documented a similar drawing of the silhouetted "Cherokee class," representing the HMS *Beagle*, in a late-nineteenth century watercolor of the Keeling Island coral atoll. Richard Milner, "Seeing Corals with the Eye of Reason: A rediscovered painting celebrates Charles Darwin's view of life," in *Ethnobiology of Corals and Coral Reefs*, ed. Nemer E. Narchi and Lisa L. Price (Switzerland: Springer International Publishing, 2015), 22. Milner identified the artist as Ernest Griset. Milner 16. Based on Darwin's text in *Coral Reefs*, it is likely that Darwin's image of the ship represented the French vessel *La Coquille*. Darwin, *Coral Reefs*, note on 99.

For Trimmer, Darwin's research clarified the historic deposition of limestone layers of varying thickness in Great Britain, and was "of considerable importance in reasoning on the circumstances under which the coralline limestones of the oolitic and other more ancient systems were formed."[69]

Recall that in *Penny Magazine*, Leonard Horner had linked these oolitic limestone layers in "Diagram No. 1" to the ancient imagined landscape "Organic Remains Restored."[70] In contrast with Horner, who addressed the economic aspects of minerals for consumers, Trimmer aimed to convey the "qualitative" characteristics of minerals for *active* explorers in the British countryside and mining shafts. For this author, "a certain amount of mineral knowledge is an essential requisite to the successful study of that subject," and Pacific region geological sections were among such sources of valuable and pertinent "knowledge."[71] Darwin's drawings of coral interpreted British geology for students in the field, Trimmer reasoned, and his illustrations served as proxy for isolated practitioners of this most social of sciences.

In a second field publication titled *The Geological Observer* (1851), Henry De la Beche manipulated Darwin's image in the context of his didactic manual written for "those who may be desirous of entering upon the study of Geology, and especially in the field."[72] It is not surprising that Geological Society of London member De la Beche, director of the Geological Survey of Great Britain, aimed to recruit and train methodologically-competent geologists capable of advancing knowledge in the

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[69] Trimmer, *Practical Geology*, 445.
[70] [Leonard Horner], "Mineral Kingdom. Section 15," Penny *Magazine* 2, no. 100 (Oct. 26, 1833): 410.
[71] Trimmer, *Practical Geology*, iii.
[72] Henry De la Beche, *The Geological Observer* (London: Longman, Brown, Green, and Longmans, 1851). Citations in this chapter taken from the American edition, published the same year. Henry De la Beche, *The Geological Observer* (Philadelphia: Blanchard and Lea, 1851), xii.

discipline.[73] He argued that *The Geological Observer* offered instruction compiled in such a manner that "the experience of many years might assist, and, perhaps, abridge the labours" of students of the science.[74] De la Beche advocated guided study of cabinet "collections, with the aid of a competent person," with the goal of compressing the training period for the new geologist and "materially assist" students in identifying and selecting new evidence in the field.[75]

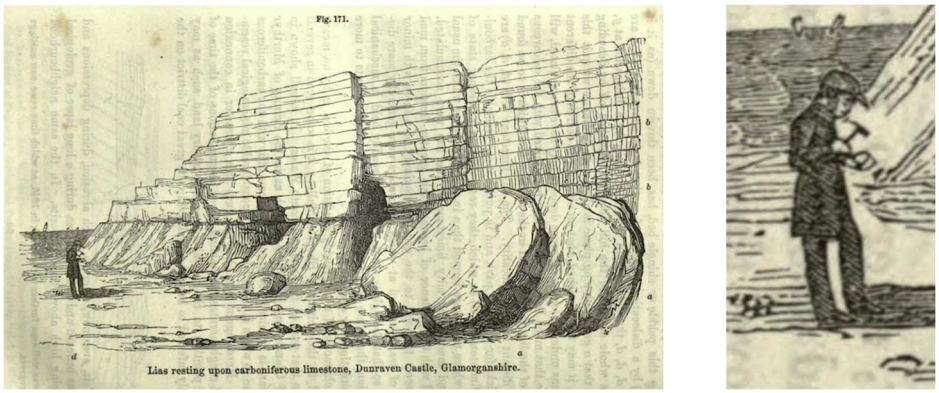

Figure 2.6. "Lias Resting Upon Carboniferous Limestone, Dunraven Castle, Glamorganshire." *Source*: *The Geological Observer* (1851), 466 and detail, student geologist with field hammer.

While *The Geological Observer* was not formatted for easy transport – the American edition contained nearly seven hundred pages – Cynthia V. Burek and Thomas A. Hose situate such illustrated volumes under the genre of geological "field skills texts," or manuals, considered critical guides for field work conducted during site explorations. For Burek and Hose, the publication of such guides coincided with "the emergence of the numerous naturalists' societies and field clubs" instructing those for whom geology was

[73] On De la Beche and his role in the Survey, see James Secord, "The Geological Survey of Great Britain as a Research School, 1839-1855," *History of Science* 24 (1986): 224. On De la Beche's involvement with the Devonian Controversy, see Rudwick, *The Great Devonian Controversy*, Secord, *Controversy in Victorian Geology*.
[74] De la Beche, *The Geological Observer*, xii.
[75] De la Beche, *The Geological Observer*, xxxii.

an avocation, not a career.[76] As revealed in the above illustration, "Lias Resting Upon Carboniferous Limestone, Dunraven Castle, Glamorganshire," the Geological Survey founder directed the lone student to explore specific "neighborhoods" in which limestone configurations illustrated "depressions and elevations beneath and above the sea during a long lapse of geological time," including those recently exposed for viewing following improvements to local roads.[77] De la Beche designed his work to focus the attention of each new geological recruit to the wealth of local geological field opportunities in Britain through which to directly contribute to the broader Geological Survey's emerging research in the service of the national interests.

De la Beche's alterations to Darwin's image satisfied his goal for readers to acquire discernment in the field under a compressed training regime. In contrast to Trimmer's application of Darwin's theory for the visualization of limestone strata, De la Beche sought more broadly to educate about the impact of the *rate* of subsidence on organic remains embedded in limestone viewed in the field.[78] De la Beche instructed students to first examine studies of coral reefs and islands. Next, he urged them to apply the field work and coral deposition theories of Darwin and others engaged in research in Pacific Ocean, African coast, and West Indies regions to the geology of the northern hemisphere. Understanding research in the dynamics of geology in the Southern Hemisphere would enable students to visualize the historic oscillation of British,

[76] Burek and Hose, "The Role of Local Societies in Early Modern Geotourism," 97. Hose, "Geoheritage in the Field," 111.
[77] De la Beche, *The Geological Observer*, 465-466, note on 465.
[78] De la Beche, *The Geological Observer*, 523.

European, and Mediterranean land masses, and its impact on the formation and composition of rocks viewed in cabinets and in the field.[79]

In a single woodcut incorporating conventional cross-section diagram markings, *The Geological Observer* reproduced *Coral Reef*'s three images of the formation of coral reef configurations to denote fringing reefs, barrier reefs, and structures Darwin had termed atolls.

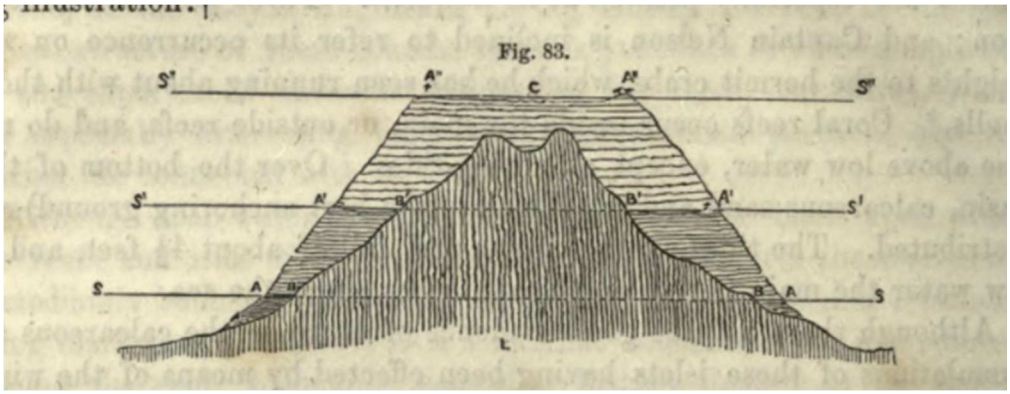

Figure 2.7. "[T]he two diagrams given by Mr. Darwin (Structure of Coral Reefs, pp. 98 and 100), have, for convenience, been thrown into one." *Source*: *The Geological Observer* (1851), 212.

De la Beche superimposed the serial coral reef formation illustrations, shifting the focus from what Darwin had regarded as the surface "features" of the Pacific region reefs, to highlight the emergence over time of the coral-based submarine "foundation of solid rock."[80] De la Beche was not the first to modify Darwin's drawings in this manner. In his review of *Coral Reefs*, Charles Maclaren printed in 1842 a woodcut illustration that compressed the serial coral growth illustrations while maintaining the argument for change over time.

[79] De la Beche, *The Geological Observer*, 206-207.
[80] Darwin, *Journal of Researches* (1845), 475, 473.

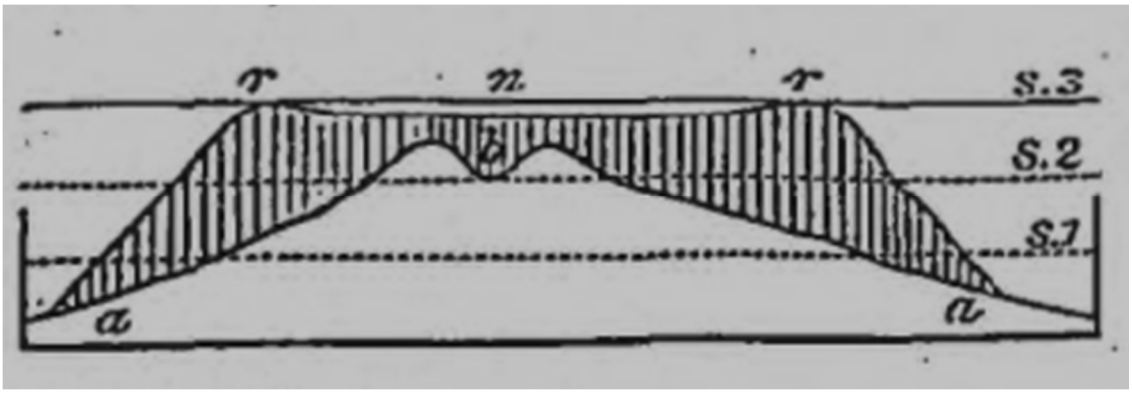

Figure 2.8. "The Reef Becomes an Atoll." *Source*: *The Scotsman* (Nov. 9, 1842): 2.

Maclaren adapted Darwin's series into "subjoined figures [that] illustrate," he explained, "the process by which a 'Fringing reef' passes into a 'Barrier reef,' and a barrier reef into an 'Atoll.'"[81] De la Beche's adaptation was likewise deliberate, and fully disclosed in a footnote. "In this section the two diagrams given by Mr. Darwin (Structure of Coral Reefs, pp. 98 and 100), have, for convenience, been thrown into one; in other respects they are the same."[82] De la Beche's diagram added horizontal striations to replace Darwin's negative space situated below the floor of the shallow coral reef lagoon. De la Beche's use of cross-hatching markings, varying in density and orientation, indicated visually for the general reader the merits of both descriptive and dynamic geological theory in explaining the resulting layers of coral limestone deposited over time. The section in *The Geological Observer* was consistent with geological conventions that narrated the layers of rock in the chronological order of deposition.[83]

[81] [Charles Maclaren], "Coral Islands and Reefs," *The Scotsman* (Nov. 9, 1842): 2.
[82] De la Beche, *The Geological Observer*, note on 212. He retained, for example, Darwin's palm trees – one on the left, and two on the right. Regarding the horizontal lines in Darwin's image marking the "Level of the Sea," De la Beche indicated this layer using the letter "S." De la Beche considered Darwin's research in the broader context of international studies on coral reefs, while highlighting Darwin's personal field investigations and thorough research. De la Beche, *The Geological Observer*, note on 179, 179-216.
[83] De la Beche, *The Geological Observer*, 212.

De la Beche's drawing conveyed to inexperienced researchers encountering British coral limestone that historic coral deposits were built *up* from the ocean floor, inverting Darwin's focus on present-day activity in reef construction. The resulting section offered a alternate visualization for students of the overall extent of the deposited coral mass that more closely approximated lessons learned during British field investigations. De la Beche explained in his narrative the relevance of this woodcut to his readers' interpretation of their field encounters with local limestone armed with both hammer and sketch pad. The geologist argued using his modified section diagram of the Pacific region reef, that "no small amount would be required to fill in, as it were, the space between the outer crust of the rising reefs and the original land."[84] This volume amassed slowly, moreover, in both historic and contemporary scenarios through the deposition of both plant and animal organic remains, "supposing a very gradual subsidence continued through a long lapse of time."[85] In this respect, De la Beche noted, the "labours of Mr. Darwin," in his first-hand study of coral "accumulations" in the "tropical regions" offered a valuable framework for his recruits regarding the formation and composition of strata containing organic remains in regions such as Dunraven Castle, Glamorganshire.[86] Global coral research in colonial regions reframed the public education in the identification of the deposition patterns observed in the field study of local British limestone reserves.

As a final example of Geological Society of London members' adaptation of Darwin's drawings, Thomas Wright's field guide published in *Proceedings of the*

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[84] De la Beche, *The Geological Observer*, 213.
[85] Ibid.
[86] De la Beche, *The Geological Observer*, 179, 466.

Cotteswold Naturalists' Field Club informed the activities of local amateur geologists investigating specific geographic regions in Britain. Wright, accepted to the Geological Society of London during the late 1850s, traveled with club members and explored a radius around Cotteswold Hills that encompassed specific regional coral limestone configurations.[87] The author had recorded field discussions and "observations I have from time to time made to our members, by way of explanation, when different Coral beds met with in our rambles."[88] Wright based his article "On Coral Reefs Present and Past" on field lectures delivered during the mid-1860s, and his published work extended these experiences to broader reading communities within the Cotteswold region.[89]

For Wright, visible "ancient coral reefs" in Britain provided an opportunity to instruct club members on the application of studies of coral growth to explain a specific geological maxim: Charles Lyell's argument for uniformitarianism.[90] Here, Charles Kingsley's *Town Geology*, published two years after Wright's article in *Proceedings of the Cotteswold Naturalists' Field Club*, offers a context for contemporary mid-Victorian public conversations on the scientific theory on uniform forces applied colloquially to local geology. Kingsley noted the forty years which elapsed "since that great and sound idea has become rooted in the minds of students, and specially of English students." Lyell had

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[87] Thomas Wright was accepted to the Geological Society of London in 1859.
[88] Thomas Wright, "On Coral Reefs Present and Past," *Proceedings of the Cotteswold Naturalists' Field* Club 4 (1868): 97. On the geographic distribution of late-Victorian era English field clubs, including the "well-known" Cottesworld Naturalists' Field Club, see for example Michael A. Salmon, Peter Marren, and Basil Harley, *The Aurelian Legacy: British Butterflies and Their Collectors* (Berkeley: University of California Press, 2000), 44.
[89] Wright, "On Coral Reefs Present and Past," note on 97.
[90] Wright, "On Coral Reefs Present and Past," 98.

> taught us to see — what common sense tells us — that the laws which we see at work around us now have been most probably at work since the creation of the world; and that whatever changes may seem to have taken place in past ages, and in ancient rocks, should be explained, if possible, by the changes which are taking place now in the most recent deposits.[91]

Discussing "one of the finest examples of a fossil Coral reef that I am acquainted with in our district," Wright provided the coordinates of a recent excursion and mapped the location, recalling the "best exposure of this Coral reef is near Frith quarry, on the northern spur of Brown's Hill, about two miles from Stroud."[92] It was through the author's record of these journeys in the field that the Geological Society member explained to club members the similarities between the mechanisms which led to the formation of "ancient and modern" coral limestone strata.[93] "These organisms further attest to the fact, that the regions of the globe in which fossil Corals are found, were formed under physical conditions similar to those that now prevail in the Indo-Pacific Ocean."[94] The "first to explain" such coral growth, Wright noted, was "Mr. Darwin."[95]

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[91] Knight, *Town Geology*, 9.
[92] Wright, "On Coral Reefs Present and Past," 149. Wright made "several journeys, for the purpose of collecting specimens," yet found that upon his return, "much of it has been removed for road-mending. Still enough of it remained," he noted, "to give a finishing touch to my former notes." Ibid.
[93] Wright, "On Coral Reefs Present and Past," 98. Compare with Darwin, *Journal of Researches* (1845), 321 and 482.
[94] Wright, "On Coral Reefs Present and Past," 119. As in De la Beche's guide, Wright acknowledged the reef studies of researchers including Americans James Dwight Dana and Louis Agassiz, the German naturalist Christian Ehrenberg, and the British geologist Joseph Beete Jukes. See for example, Wright, "On Coral Reefs Present and Past," 99.
[95] Wright, "On Coral Reefs Present and Past," 119. Wright cited both *Coral Reefs* and *Journal of Researches* in his discussion. Wright, "On Coral Reefs Present and Past," note on 103, notes on 104-105, 112. As in De la Beche's guide, Wright acknowledged the reef studies of researchers including Americans James Dwight Dana and Louis Agassiz, the German naturalist Christian Ehrenberg, and the British geologist Joseph Beete Jukes. See for example, Wright, "On Coral Reefs Present and Past," 99.

For Wright, Charles Darwin's visualization of his theory of current coral growth clearly modeled the appearance of the limestone strata viewed in localities visited by Cotteswold Field Club members near the English city of Stroud.[96] In Wright's chronicle of his field lecture, he speculated on the age of a coral fossil-laden limestone specimen which he gauged at "15 to 20 feet in thickness," noting "it must have formed a Barrier reef of considerable magnitude in the Jurassic sea."[97] In "On Coral Reefs Present and Past," Wright included *two* composite images derived from Darwin's original woodcut illustrations, identical in outline but with reverse shading, to emphasize in turn the reef formation and the land depression.

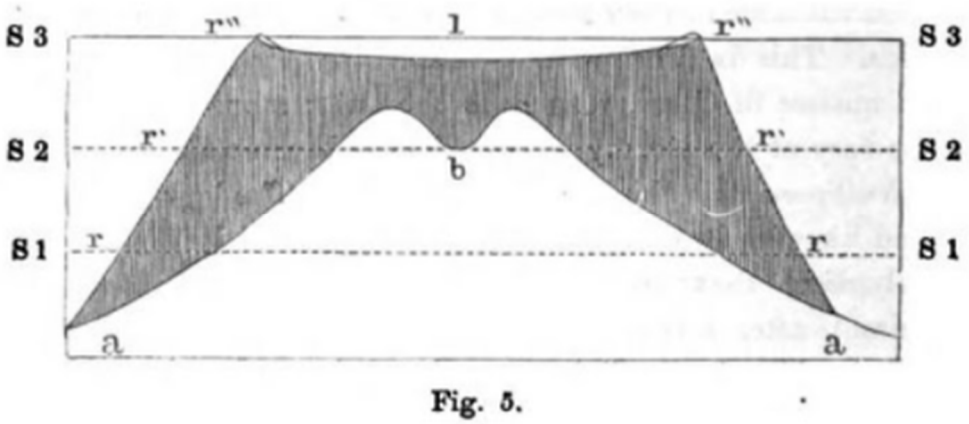

Figure 2.9. "A section of the island, after a subsidence of several hundred feet." *Source*: *Proceedings of the Cotteswold Naturalists' Field* Club (1868): 114 (detail).

[96] Wright, "On Coral Reefs Present and Past," 97-98, 149.
[97] Wright, "On Coral Reefs Present and Past," 149.

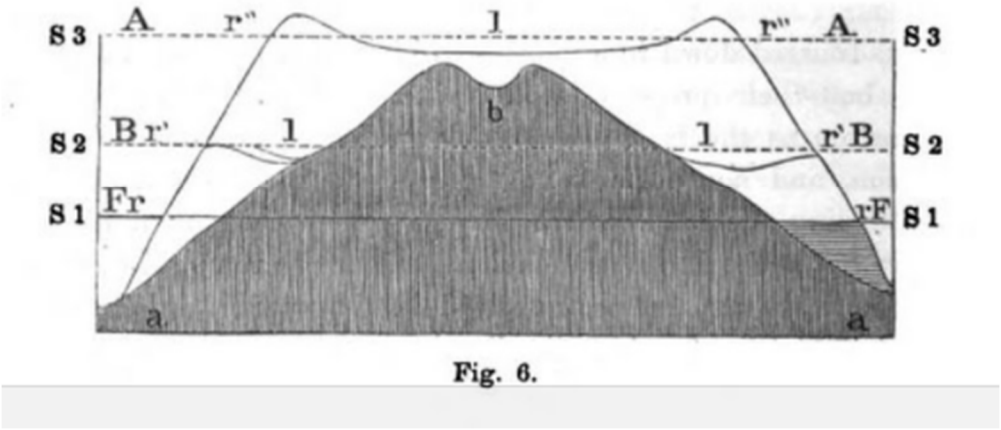

Figure 2.10. "There will remain only a perfect Atoll." *Source*: *Source*: *Proceedings of the Cotteswold Naturalists' Field* Club (1868), 114 (detail).

The first diagram, shown above left, demonstrated the historic submarine deposition of coral rock, delineated in a manner similar to the patterns used by Henry De la Beche in *The Geological Observer*. Wright's woodcut visualized the thickness of the coral mass. It simultaneously indicated the "living and growing outer margin of the reef" constructed at sea-level and its expanding foundation over former coral activity.[98] The second, pictured above right, depicted the uniformitarianism forces by accounting for the contemporary activity of surface coral growth in response to subsidence, and contained a shaded area modeled after Darwin's woodcut in *Coral Reefs* and *Journal of Researches*. This negative image represented a time-lapse view of the volume of reef material formed, its deposition concurrent with the sinking ocean floor. In this latter drawing, the legend revealed that the markings "Fr = fringing, B = Barrier, A = atoll," and his emphasis

[98] Wright, "On Coral Reefs Present and Past," 114.

placed on the island indicated that geologist's theory supported all three formations "at three different periods of time."[99]

Thomas Wright's article "On Coral Reefs Present and Past," published in *Proceedings of the Cotteswold Naturalists' Field*, demonstrates the facility with which Geological Society members wove Darwin's Keeling Island studies into local geological narratives. The author's notes on coral limestone configurations observed in the field stressed that "many palaeozoic and secondary rocks may be said to be ancient Coral reefs, which appear to have been formed under conditions analogous to those now in operation in the waters of the Pacific Ocean."[100] Moreover, in this narrative written for the mid-Victorian era general reader, the "careful investigation of the *modus operandi* of modern agents is indispensable to the right comprehension of those which prevailed in ancient time."[101] Wright confidently asserted Darwin's comprehensive argument for contemporary coral growth provided vital clues as to the process of historic limestone deposition viewed during rambles "near Frith quarry."[102] In this guide for English field club members, contemporary colonial coral activity explained historic geological forces operating on their ancient island and visible "about two miles" from their own neighborhood.

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[99] Wright, "On Coral Reefs Present and Past," 114-115.
[100] Wright, "On Coral Reefs Present and Past," 98. Compare with Darwin, *Journal of Researches* (1845), 321 and 482.
[101] Wright, "On Coral Reefs Present and Past," 118.
[102] Wright, "On Coral Reefs Present and Past," 149.

Discussion

When Charles Kingsley linked for his Victorian readers Darwin's "observations which he made in the world-famous Voyage of the *Beagle*" with local coral limestone, he extended an ongoing narrative of British scientific agency over global coral research first presented to the general reader through penny magazines during the 1830s.[103] This section has demonstrated how Geological Society of London members conveyed that the history of the science of geology was in many respects the history of coral research. "The Oolitic formations will long remain classic ground to English Geologists, as it was during the study of these rocks," Thomas Wright contended, "that Dr. William Smith first obtained the facts which enabled him to 'identify strata by organic remains,' and thereby to establish a true natural system of Stratigraphical Geology."[104] Indeed, as Wright noted, coral fossil strata layers were, from the start, a resource of intense interest to the earliest British geologists.

These geologist-authors educated British readers and urged them to consider the relevance of an understanding of the extent of indigenous coral limestone resources to their daily lives. Leonard Horner's series, with the full-page woodcut illustration titled "Organic Remains Restored," explored the link between coal and coral stores – as plant and animal fossils extracted from mines and quarries – as resources critical to imperial expansions during the industrial age. This scientist addressed burgeoning consumer readerships and offered geology as a lens through which to visualize secure social and political foundations. Horner's tutorial explained the significance of various geographies of extraction, in regions including Bath, Ketton, and Portland, as local sources of coral

[103] Kingsley, *Town Geology*, 181.
[104] Wright, "On Coral Reefs Present and Past," 144.

limestone used the national architecture of buildings representing British imperial power. Horner also invoked a second geographic framework – the colonial regions of Australia and New Holland – to explain the volume of indigenous limestone available to supply food and housing needs in the form of fertilizer and mortar. Horner's argument, appearing first in the inexpensive and broadly circulated *Penny Magazine* from 1833-1835, and later reprinted in *Knight's Store of Knowledge for All Readers* (1841), considered the height of the "systems of beds" of coral-fossil-laden limestone layers with its "united thickness being about 2600 feet."[105] His analogy between the mariners' and missionaries' descriptions of the geographic expanse of Pacific coral reefs – visible at the surface of the ocean – with the miners' and British geologists' field studies conducted during the 1820s and 1830s served to emphasize the impact of this "new science" on the daily lives of the readers of the penny press.

While geologists including Horner had "restored" past coral growth in imagination, Geological Society members soon recognized the potential for Charles Darwin's coral reef theory to reconstruct and portray historical Britain in terms of contemporary coral growth. The "fossil coral reefs" extending in strata "several thousand feet thick," as Charles Kingsley explained, represented a geological mass interconnected in space and time and "which spread over Somersetshire and South Wales, around the present estuary of the Severn, — and those, once perhaps joined to them, which spread from Derby to Berwick, with a western branch through North-east Wales."[106] Kingsley

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[105] [Horner], "Mineral Kingdom, Section 2," 20. [Leonard Horner], "Mineral Kingdom. Section 6," *Penny Magazine* 2, no. 66 (Apr. 13, 1833): 142-143.

[106] Kingsley, *Town Geology*, 186. Here, Kingsley drew readers' attention to "'cherty, or flinty, beds" at the transition between millstone grit strata and mountain limestone. On chert limestone layers as the source of Staffordshire pottery, see for example Thomas Noble, ed. *The History and Gazetteer of the County of Derby* (Derby: Stephen Glover, 1831), 73.

had access to compelling geological – not geographic – coral reef research with which to explain the origins of Britain's foundational layers of rock.

The mid-Victorian decades represented a period of rapid change in British society, and the case studies in this chapter demonstrate shifts within the local education in field geology responding to the changing nineteenth-century landscape. Some sections of Britain, as Society members recognized, remained isolated from urban centers. Joshua Trimmer aimed to reach those in remote regions during a period of transition in miners' geological education through the recently-formed School of Mines and Museums of Economic Geology and Practical Geology. In other regions, technology irreversibly altered the focus of the evolving science. By the 1850s, the new Britannia Bridge expanded research opportunities, and in his field manual De la Beche urged students to capitalize on access to these newly accessible regions. In contrast, Thomas Wright complained about the road work disrupting – and destroying – exposed regions ripe for geological study. Throughout, however, Society members argued that Darwin's field coral research in the Pacific Ocean colonial regions remained relevant for the general reader conducting geological studies in Britain. Readers encountered Darwin in their own study of domestic fields, guide books in hand. Darwin's images and diagram sections – modified to suit the individual author's needs to reach these local audiences – served as a visual short-hand for the interpretation of historic limestone formation in the context of British geological efforts to advance understanding of the vast economic potential stored in the nation's geological foundation.

Lecturing and publishing a generation after Horner in *Town Geology*, Kingsley had used Darwin's research in the Pacific, a region he termed the "beautiful and precious

South-Seas Islands," to explain to the Chester residents the historic process of local limestone coral strata deposition viewed on field excursions.[107] Charles Darwin had included a map of these regions in his geological work *Coral Reefs* (1842). The physical appearance of reefs, he explained, provided evidence on the surface for unseen regions of elevation and subsidence. For Darwin, the changing relationship between the reef and the land – initially lying in close proximity, later separated by a deep harbor, and ultimately erased as the land subsided entirely from view – visualized the movement of the Pacific-region ocean floor over time.[108] Within decades, however, the popular magazine *Chambers's Journal* identified this geological chart of coral growth in terms of British economic potential.

> Mr. Darwin, some years ago, prepared a map in which were put down all the reefs of coral which surround the numerous islands in the Pacific. In one almost straight line of ten thousand miles, from Pitcairn Island to China, those reefs stud the vast ocean.[109]

In the article "Gems of the Sea," *Chambers's* repurposed Darwin's illustration of Pacific regions undergoing subsidence as prospective regions from which to extract decorative coral. The author of the article predicted British-controlled supplies of the commodity profitably extracted from *foreign* waters. The "really grand growths of coral" extended east to west, *Chambers's* pronounced in 1870, and promised future sites of British imperial market expansion.[110]

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[107] Kingsley, *Town Geology*, 183-184.
[108] Darwin, *Coral Reefs*. Darwin narrated the map in *Journal of Researches*. Darwin, *Journal of Researches* (1845), 479-480. Sponsel, "Coral Reef Formation," 221-226.
[109] "Gems of the Sea," *Chambers's Journal of Popular Literature, Science and Arts* (May 21, 1870): 327.
[110] Ibid. *Chambers's* provided the history of Pitcairn Island and the late eighteenth-century mutiny of the crew of the *Bounty*. "The Pitcairn Islanders in 1849," *Chambers's Edinburgh Journal* 314 (Jan. 5, 1850): 10-12. On contemporary views of the opium wars, see for example Arthur Cunynghame, *An Aide-de-*

The next chapter explores Victorian publications that interpreted coral growth in the context of British economic and political opportunities in the Pacific regions mapped by Darwin. Sarah Maria Smythe was a member of the generation of female middle-class Victorians reached by Geological Society of London and Geological Survey members' lectures and publications explaining geological theory. In turn, Smythe functioned in a manner which Rudwick had identified as "accredited" participants in geological field work as she accompanied her husband on military explorations of Pacific island regions during the active period of colonial expansion.[111] In her published collection of letters Smythe applied Darwin's coral growth theory during a geographic expansion of British imperial reach. British geological theory – in the hands of the public – framed encounters with coral located in colonial regions.

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camp's Recollections of Service in China: A Residence in Hong-Kong, and Visits to Other Islands in the Chinese Seas, vol. 1 (London: Saunders and Otley, 1844), 56, 80. Robert Bickers, "Britain and China, and India," in Robert Bickers and Jonathan J. Howlett, eds. *Britain and China, 1840-1970: Empire, Finance and War* (London, New York: Routledge, 2015), 58-83.

[111] Rudwick, "Charles Darwin in London," 191.

CHAPTER 3

The Collected Letters of Sarah Maria Smythe: From the Fijian Reefs to Readers in Belfast, 1858-1864

> The theory of the formation of the coral reefs, proposed by Darwin … explains so many puzzling facts.
>
> Sarah Maria Smythe, daughter of a Belfast Minister writing from Fiji
> Summer 1860 [1]

Writing in *On the Origin of Species* in 1859, Charles Darwin recalled with "surprise" the extent to which his theory regarding measurements of the oscillations of the earth's crust disseminated among readers beyond the confines of his own works. "Since publishing my views on this subject in 1845, I have watched the progress of Geology, and have been surprised to note how author after author, in treating of this or that great formation, has come to the conclusion that it was accumulated during subsidence."[2] For Darwin, "author after author," text after text, conveyed the points he meticulously explained in his revised – and illustrated – "Keeling Island" chapter in *Journal of Researches*.

Darwin recorded in his reading journal the names of some of these authors. Between 1845 and the end of the 1850s, he listed Charles Lyell, Joseph Beete Jukes, Mary Somerville: each included in their own publications Darwin's argument that coral reef growth measured subsidence.[3] Each, moreover, specifically linked the name of

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[1] Mrs. [Sarah Maria] Smythe, *Ten Months in the Fiji Islands* (Oxford and London: John Henry and James Parker, 1864), 21-22.
[2] In this excerpt, Darwin referred to "ancient formations, which are rich in fossils." Charles Darwin, *On the Origin of Species by Means of Natural Selection* (London: John Murray, 1859), 291.
[3] Darwin, *Journal of Researches* (1845), 470, 477. "What Darwin Read: Darwin's reading notebooks," *Darwin Correspondence Project*, accessed July 18, 2016, https://www.darwinproject.ac.uk/what-darwin-

Charles Darwin with subsidence theory, writing for the popular reader in demographics ranging from émigrés settling in colonial Australia to expanding audiences of female readers.[4] There were other authors as well who applied Pacific coral reef theory to British local geological formations. As mentioned in the previous chapter, Joshua Trimmer explained Darwin's subsidence theory in a popular work for British miners, illustrated by cross-section woodcuts that pre-date those published in Darwin's monograph *Coral Reefs*. Trimmer applied "the theory proposed by Mr. Darwin" in order to explain "many examples" of alternating bands of rocks in the British Islands, Scotland and North Wales.[5] *Chambers Edinburgh Journal* included Darwin's Pacific Ocean subsidence theory in a book review of Lyell's latest edition of *Principles of Geology*.[6] In addition to his public speaking engagements on Darwin's theory, geologist Gideon Algernon Mantell published a discussion on subsidence theory for readers of the Religious Tract Society's *The Visitor, Or, Monthly Instructor*.[7] For Darwin, what was significant in the number and diversity of these publications is the extent to which his

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read/darwin-s-reading-notebooks. See for example Darwin's entry for Charles Lyell, (DAR 119: 18a), Joseph Beete Jukes (DAR 119: 20a), James Dwight Dana (DAR 119: 22a), and Mary Somerville (DAR 119: 22).

[4] Joseph Beete Jukes, *Narrative of the Surveying Voyage of HMS Fly*, vol.1 (London: T. & W. Boone, 1847), 117. Mary Somerville, *Physical Geography* new edition, vol. 1 (London: John Murray, 1849), 148. On Somerville as a popularizer of science writing for the "knowledgeable adults, including men," see Bernard Lightman, *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago: University of Chicago Press, 2007), 21-22.

[5] Joshua Trimmer, *Practical Geology and Mineralogy; With Instructions for the Qualitative Analysis of Minerals* (London: J. W. Parker, 1841), 445.

[6] "Rising and Sinking of Land in Northern Europe," *Chambers's Edinburgh Journal* 184 (Jul. 10, 1847): 22-24. Chambers discussed Darwin with regard to British coral limestone in the 6th edition and the people's edition of *Vestiges*. Anonymous [Robert Chambers], *Vestiges of the Natural History of Creation*, 6th ed. (London: John Churchill, 1847), 70.

[7] Darwin, *Journal of Researches* (1839), 547 quoted in [Gideon] M[antell], "Coral Islands. No. II," *The Visitor, Or, Monthly Instructor* (Apr. 1845): 157-159. 158. Also [Gideon] M[antell], "Coral Islands. No. I," *The Visitor, Or, Monthly Instructor* (Mar. 1845): 119-120, [Gideon] M[antell], "Coral Islands. No. III," *The Visitor, Or, Monthly Instructor* (May 1845): 172-174, [Gideon] M[antell], "Coral Islands. No. IV," *The Visitor, Or, Monthly Instructor* (Jun. 1845): 206-208. Note that these articles were printed before Murray released Darwin's second edition in August 1845.

name was promoted in the public sphere in connection with the term "subsidence" and coral growth geology during the years between 1845 and the publication of *Origin of Species*.

This chapter focuses on reader reception to mid-nineteenth century British geological theory and field research. Through published letters written from pre-colonial Fiji to friends in Britain, Sarah Maria Smythe's volume *Ten Months in the Fiji Islands* (1864) presents a salient example of how, when, and why Darwin's theory of coral growth was adopted by a Victorian-era reader and demonstrates the impact of the Geological Society of London members' outreach in the context of imperial resource management.[8] Smythe's use of subsidence to explain the reef architecture to her readers is striking because it reveals that the author and her Victorian-era community applied British research in geology to frame public conversations about social, political, and scientific aspirations in colonial regions. Her publication, moreover, documents the public use of geology in the early 1860s as one element in a mid-Victorian era toolkit – along with scientific methodologies including botany and magnetical studies – with which to quantify nature and resources in imperial environments.

It is not surprising that Sarah Maria Smythe discussed the topic of coral in correspondence written from the Pacific region. In January of 1860, Mrs. Smythe had departed with her husband Colonel William James for an extended evaluation of the military and commercial viability of proposals to annex the coral-laden Pacific islands two years after Great Britain had initiated a formal exploration of the Fiji archipelago.[9]

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[8] Smythe, *Ten Months in the Fiji Islands*, 21-22.

[9] W. J. Smythe, "Introduction," in *Ten Months in the Fiji Islands* (Oxford and London: John Henry and James Parker, 1864), v. *Dictionary of National Biography* (1898) s.v. "William James Smythe." For a recent account of Colonel Smythe's negotiations, see John Spurway, *Ma`afu, Prince of Tonga, Chief of*

The daughter of a prominent Belfast family, Smythe communicated with "friends at home," her husband explained, throughout her travels in the archipelago. In her letters, she conveyed the constant threat of shipwreck during multiple negotiations through narrow reef openings.[10] As Berthold Seemann, the Royal Botanic Gardens, Kew scientist assigned to the mission later confirmed, British plans to annex the archipelago for its potential as a military post, mail station, and source of cotton for Victorian-era manufacturers relied on accurate readings of safe passages through reef architecture, particularly in regions lacking adequate navigational maps.[11] As Smythe related to her readers, Darwin's research into coral growth patterns predicted the location of critical gaps in the reefs.[12]

Sarah Maria Smythe both wrote and received mail in Fiji from friends in her home region of Belfast during a period of active mid-nineteenth century public education on the subject of geology. Her collected letters were conversations with reading communities in a format distinct from written epistles or published diary entries. The circulation of Smythe's letters in both their ephemeral and more permanent format must be considered in the context of the intellectual climate in the mercantile town of Victorian-era Belfast, in order to understand how she and her correspondents first encountered, then used, theories based on British coral geological research. The year before Smythe and her husband departed for Fiji, the Belfast Museum hosted a series of

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Fiji: The Life and Times of Fiji's First Tui Lau (Australian National University Press, 2015), 183-184 and chapter 6. Spurway noted that Mrs. Smythe and Berthold Seemann offered contradictory opinions regarding the authority of the Fijian leadership.

[10] W. J. Smythe, "Preface," in *Ten Months in the Fiji Islands* (Oxford and London: John Henry and James Parker, 1864), iii.

[11] Berthold Seemann, *Viti: An Account of a Government Mission to the Vitian or Fijian Islands in the Years 1860-1861* (Cambridge: Macmillan & Co., 1862), 141.

[12] Smythe, *Ten Months in the Fiji Islands*, 21-22.

lectures by James Macadams, a member of the Geological Society of London.[13] Newspapers noted the public interest in geology following his series on "Organic Remains" at this Northern Ireland center for science education in which Sarah Maria's family were active participants.[14] Correspondents received Smythe's letters as Joseph Beete Jukes, the director of the Geological Survey's project in Ireland and former reef geologist, delivered talks including the topic of coral geology that inspired the founding of the Belfast Naturalists' Field Club.[15]

The specific source of Sarah Maria Smythe's information about Darwin's theory cannot be stated with certainty. It is possible that Seemann, botanist assigned by Kew and correspondent of Darwin, had discussed the geologist's theory with her at Fiji, although the date of her letter discussing the gaps in the coral reefs was prior to their meeting at Levuka.[16] Nor was *Ten Months in the Fiji Islands* the only publication to reference British geologists' research on Pacific coral growth in the context of the mid-century annexation debate.[17] Since her letters have not been located it is not possible to

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[13] *The Quarterly Journal of the Geological Society of London* 5 (London: Longman, Browne, Green, and Longmans, 1849): vi. *Northern Whig*, reprinted in "Mr. James McAdam," *Journal of the Royal Geological Society of Ireland* 9, no. 2 (Dublin: The Geological Society, 1862): 319-320.

[14] "Bland, Esq. contributed to the museum" six bird specimens, including "a small American owl." "Belfast Museum," *Northern Whig* (Jun. 23, 1858): 4. "Belfast Museum Lectures on Geology," *Northern Whig* (Dec. 2, 1858): 4. *Northern Whig* (Dec. 3, 1858): 1.

[15] "The Geological Excursion," *Ballymena Observer* (Aug. 29, 1857): 4. A. Albert Campbell, *Belfast Naturalists' Field Club: Its Origin and Progress* (Belfast: Hugh Greer, 1938), 8. "Music Hall, This Evening, at 8 p.m. Precisely, Professor Jukes' Geological Lecture. Lecture III. April 5," *Belfast Newsletter* (Apr. 5, 1861): 2. "Lectures on 'Geology'," *Belfast Newsletter* (Apr. 6, 1861): 2. "Professor Jukes' Geological Lecture," *Belfast Mercury* (Apr. 4, 1861): 2. "Lectures on 'Geology'," *Belfast Newsletter* (Apr. 6, 1861): 2.

[16] Compare Smythe, *Ten Months in the Fiji Islands*, 25 with Seemann, *Viti*, 120. Berthold Carl Seemann to Charles Robert Darwin, 24 Apr 1862, DAR 177: 130, DAR 50: E28. Letter no: DCP-LETT-3518.

[17] Wesleyan Methodist missionary Thomas Williams published *Fiji and the Fijians* in 1858, concurrent with Consul Pritchard's proposal to acquire the archipelago as a British colonial region. Williams argued against Darwin's coral theory to claim that the reefs were receding. Thomas Williams, *Fiji and the Fijians*, vol. 1 (London: Alexander Heylin, 1858), iii, 11. Authors writing from Southern Hemisphere reefs about Darwin to friends in Britain and America from the 1870s through the 1890s, concurrent with the second edition of Darwin's *Coral Reefs* and the explorations of the HMS *Challenger*, included Mrs. [Annie] Brassey, *A Voyage on the* Sunbeam, *Our Home on the Ocean for Eleven Months* (London: Longmans,

verify if these passages were original to her 1860 correspondence or inserted prior to their publication in 1864. Close readings of her set of published letters reveal signs of editing, what Claudia Knapman has regarded as an acceptable feature of this genre of colonial Pacific narratives penned by mid-nineteenth century British women traveling to the Pacific.[18] What is significant, however, regarding her application of Darwin's theory is her consideration of the implications of a geological framework to account for coral growth patterns. As Sarah Maria Smythe employed subsidence theory to explain her independent observations of the tropical reef, she demonstrated the dissemination of contemporary scientific *methodology* to the Victorian public, and one amateur's facility with geological applications in the field.

Historian David N. Livingstone has urged a consideration of the influence of local geography in the reception of scientific arguments, sites where readers' collective "foundational assumptions" impact interpretation.[19] In his study of the Belfast community's vitriolic debates regarding natural selection, for example, Livingstone demonstrated that reader reception of *Origin of Species* in Northern Ireland during the 1870s supported his argument that the interpretation of Darwin's texts varied locally. As Livingstone has argued, "*where* scientific texts are read has an important bearing on *how*

Green, and Co., 1878), 209-210, and Mrs. [Caroline Martha] Edgeworth David, *Funafuti or Three Months on a Coral Island: An Unscientific Account of a Scientific Expedition* (London: John Murray, 1899), 292-304. See also Charles Ives, *The Isles of Summer; or Nassau and the Bahamas* (New Haven, CT: Published by the Author, 1880), 212, and Henry Adams, "Páoara, February 26, 1891," in *Selected Letters*, ed. Ernest Samuels, (Cambridge, MA: The Belknap Press of Harvard University Press, 1992), 242. I thank Dr. Jude Pfister for bringing Henry Adams's travels to Fiji to my attention.

[18] Smythe, *Ten Months in the Fiji Islands*, 31, 57. Claudia Knapman, "Western Women's Travel Writing about the Pacific Islands," *Pacific Studies* 20, no. 2 (1997): 32, 33-34.

[19] David N. Livingstone, *Dealing with Darwin: Place, Politics, and Rhetoric in Religious Engagements with Evolution* (Baltimore: Johns Hopkins University Press, 2014), 5.

they are read."[20] The town of Belfast's self-identification as a region participating in the larger British imperial investigations of colonial natural resources, combined with a robust schedule of public lectures on the topic of coral geology, informed what Livingstone termed the "foundational assumptions" of Smythe's reading community during the late 1850s and early 1860s.[21] Read concurrently with the British field guides in which practitioners investigated the countryside "hammer in hand," her work adds to the evidence that during the decades following the circulation of Geological Society of London members' research, general audiences employed geological theories when reading historic and contemporary evidence of coral growth in the context of imperial resource management.

This chapter first situates Smythe's experience in Fiji during her months spent on the archipelago prior to annexation during British imperial explorations of the islands' resources. Next, her letters and illustrations disclose her viewing and recording of three geological aspects of the Fijian reef environment: the understanding of current reef growth, the anticipation of future coral activity, and an explanation for the absence of coral in specific regions in the island geography.[22] The inclusion of the imprint of the

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[20] David N. Livingstone, "Science, Text and Space: Thoughts on the Geography of Reading," *Transactions of the Institute of British Geographers* 30, no. 4 (2005): 391. Emphasis original.

[21] As Barry Crosbie recently observed, mid-century Irish scientific institutions contributed to British colonial expansion efforts as participants in the "imperial web of connections." Barry Crosbie, "Ireland, Colonial Science, and the Geographical Construction of British Rule in India, c. 1820-1870," *The Historical Journal* 52, no. 4 (2009): 987. On the Belfast Museum's natural history collection, see Jonathan Jeffrey Wright, "'A Depot for the Productions of the Four Quarters of the Globe': Empire, Collecting and the Belfast Museum," in *Spaces of Global Knowledge: Exhibition, Encounter and Exchange in an Age of Empire*, eds. Diarmid A. Finnegan and Jonathan Jeffrey Wright, (Farnham, UK and Burlington VT: Ashgate, 2015), 147. Also John Wilson Foster and Helena C. G. Chesney, eds. *Nature in Ireland: A Scientific and Cultural History*, (Dublin: Lilliput Press, 1997), 97-101. Edna Leaney, "Science," in *The Irish Book in England, 1800-1891* ed. James H. Murphy (Oxford: Oxford University Press, 2011), 531, 539. Marc Serge Rivière, "From Belfast to Mauritius: Charles Telfair (1778-1833), Naturalist and a Product of the Irish Enlightenment," *Eighteenth-Century Ireland* 21 (2006): 137.

[22] It is outside the scope of this chapter, but Smythe also evaluated the geological features of Fijian island rock formations in text and drawing. Smythe, *Ten Months in the Fiji Islands*, 168.

celebrated chromolithographer Vincent Brooks in *Ten Months in the Fiji Islands*, together with an appendix containing Kew director William Hooker's commission letter and reports of scientific magnetic measurements using Royal Botanic Gardens-supplied instruments, situates Smythe's use of Darwin's theory of coral growth to record geographically-specific reef landscapes within the mission's broader projects documenting colonial natural resources.[23] This chapter concludes by contextualizing Smythe's letters regarding coral reef growth in response to environmental change among developing discussions in Ireland as the *Origin of Species* text circulated in lending libraries and in printed reviews. Darwin had acknowledged in *Origin* that his sketch of 1844 was the first articulation of his theory of natural selection, and scholars have noted evolutionary "hints" of these thoughts in *Journal of Researches*' revised Galapagos chapter, notably in the finch woodcut drawing.[24] This project extends these studies as it demonstrates that the illustrated coral growth tutorial – published in *Coral Reefs*, his *Journal of Researches* "Keeling Island" chapter, and reproductions in British field guides examined in the previous chapter – all served to explain subsidence, a key mechanism of environmental change which, as Darwin explained, was critical to the observed natural

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[23] "Instructions Addressed to Dr. Seeman by Sir William J. Hooker, K.H., D.C.L., F.R.S., Director of the Royal Gardens, Kew," in "Appendix," in *Ten Months in the Fiji Islands*, 237-238. A third assignment was the collection of magnetic readings using equipment provided by Royal Botanic Gardens, Kew. "General Sabine," William Smythe noted, "took a lively and effective interest in the expedition." W. J. Smythe, "Introduction," iv. Smythe had worked with Sabine at the observatory at Longwood. *Dictionary of National Biography* (1909) s.v. "William James Smythe." On Kew's role in magnetic studies, see Lee T. Macdonald, "Making Kew Observatory: The Royal Society, the British Association and the Politics of Early Victorian Science," *The British Journal for the History of Science* 48, no. 3 (Sep. 1, 2015): 409-433.

[24] Darwin, *Origin*, 1. James Secord, "Introduction," in *Charles Darwin. Evolutionary Writings*, ed. James Secord, vii-xxxvii (Oxford: Oxford University Press, 2008), xiv; David Amigoni, *Colonies, Cults, and Evolution: Literature, Science and Culture in Nineteenth-Century Writing* (Cambridge: Cambridge University Press, 2007), 84; Julia Voss, *Darwin's Pictures: View of Evolutionary Theory, 1837-1874*, trans. Lori Lantz (New Haven: Yale University Press, 2010), 18. As Janet Browne has observed, Darwin undertook the revision for the second edition of *Journal of Researches* in May 1845, months following the completion of his private essay the summer of 1844. Janet Browne, *Charles Darwin. Voyaging. Volume 1 of a Biography* (New York: Alfred A. Knopf, 1995), 445.

processes of species selection. Smythe's letters written to Victorian-era Belfast readers demonstrate the circulation of her acceptance of subsidence and engagement with *theoretical* geology in mid-nineteenth century Britain.

Part 1 – A Belfast Countrywoman Reads Coral Geology

While mid-Victorian era navigational maps aimed to capture the expanding geographic extent British influence in Pacific regions, it was Darwin's detailed geological illustration of the coordinates of fringing and barrier reefs, encircling named islands in the southern hemisphere, that visualize for today's reader the challenges faced by vessels in transit throughout these territories. Sarah Maria Smythe wrote to correspondents in Belfast shortly after arriving in Fiji in July, 1860. She recalled her three-week voyage from New Zealand and the recent difficult transit across the reef surrounding the harbor at Levuka. Smythe urged her friends to consider Darwin's "theory of the formation of the coral reefs" as she explained the gaps through which her pilot had successfully navigated.[25]

Sarah Maria's collected letters revealed the reasons for her travels to Fiji and her focus on the reef crossing. Smythe, daughter of Rev. Robert Wintringham Bland, a Justice of the Peace and Dean in Belfast, Northern Ireland, had recently married Brevard Colonel William James Smythe (1816-1887), an artillery officer in his forties and the son of the vicar at Carnmoney.[26] The British Colonial Secretary assigned Smythe the primary

[25] Smythe, *Ten Months in the Fiji Islands*, 16-17, 21-22.
[26] *Dictionary of National Biography* (1898) s.v. "William James Smythe." Newspaper records of court transactions indicate that two unmarried aunts, Sarah Elizabeth Bland and Mary Anne Sinclaire Bland, owned property in Belfast with Rev. Bland as late as 1848. "In the Equity Exchequer," *Belfast Newsletter* (Dec. 15, 1848): 3.

task of evaluating the feasibility of annexing Fiji as a "useful station for any mail-steamers running between Panama and Sydney" and assessing the islands' potential contribution towards British security in the ocean region.[27] As William Smythe noted in the introduction to his wife's book, up to that point the "connection of England with the inhabitants of the Pacific has been confined to the labours of her missionaries and the occasional visits of her ships of war."[28] By May of 1861, William Smythe submitted his recommendation to the Colonial Secretary that the annexation proposal be denied for a number of reasons, primarily the tenuous nature of the political situation in Fiji. Colonel Smythe also challenged claims regarding the geographic utility of the region, as the archipelago was out of range of two existing shipping routes. Critically, "[a]lmost every island is surrounded by a coral reef," Smythe added, "the navigation among which is undoubtedly difficult and dangerous."[29]

In addition to military appraisals of the coral islands regions, the mission evaluated the potential for the archipelago to support the production of raw materials. The British press closely followed this aspect of the mission, which was of particular interest to residents of mid-Victorian urban mercantile centers including the town of Belfast.[30] Consul W. T. Pritchard had previously argued that the annexation of Fiji

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[27] W. J. Smythe, "Introduction," ii. Duke of Newcastle to W. J. Smythe, December 23, 1859, in "Appendix," in *Ten Months in the Fiji Islands* (Oxford and London: John Henry and James Parker, 1864), 194. J. D. Legge, *Britain in Fiji, 1858-1880* (London: Macmillan; New York: St. Martin's Press, 1958), 31-35. W. T. Pritchard, *Polynesian Reminiscences; Or, Life in the South Pacific Islands* (London: Chapman and Hall, 1867), 342. Spurway, *Ma`afu, Prince of Tonga*, 183. *Dictionary of National Biography* (1898) s.v. "William James Smythe."

[28] W. J. Smythe, "Introduction," i. Claudia Knapman, *White Women in Fiji, 1835-1930: The Ruin of Empire?* (Sydney, London, and Boston: Allen & Unwin, 1986), 1-2. William James Smythe advised against annexation in 1861. He printed his report in his wife's volume. William Smythe, "Colonel Smythe's Report," 210. "Review of *Ten Months in the Fiji Islands*," *The Gentleman's Magazine and Historical Review* (Mar. 1864): 369.

[29] William Smythe, "Colonel Smythe's Report," 201, 205.

[30] "The Feejee Islands as a Cotton Country," *Scottish Guardian* (Mar. 25, 1859): 2-3. "Cotton from Australia," *Belfast Mercury* (Sept. 20, 1861): 4. "Cotton Supply," *Belfast Morning News* (Oct. 9, 1861): 3.

offered specific advantages as a colonial possession despite the geographically diffuse nature of the coral reef-fringed islands. Pritchard proposed Fiji as a platform for the cultivation of raw cotton for used in textile production in industrial Britain, and had brought samples of cotton grown in the archipelago to England in late 1858.[31] Smythe later framed his commission during the years preceding the American Civil War in the context of the antebellum American supplies of cotton vital to British domestic interests, noting that "our manufactures were exposed by their dependence for raw material mainly on a single country."[32] Upon examination of the Fijian samples in Manchester, members of the Cotton Supply Association passed a "resolution," Colonel Smythe noted, with plans for "securing for this country the means of obtaining those supplies."[33] His charge was to support the government's position regarding "the use to be made of our Foreign Possessions" in the production of resources.[34]

The *Belfast Mercury* reported the successful first harvest of trial plantings at Fiji presented for review at the newspaper office in Sydney, Australia.[35] The samples were shipped directly to the Cotton Supply Association of Manchester, the *Belfast Morning News* informed, to those who had commissioned the study.[36] The *Northern Whig* announced the results of experiments in Australia demonstrating the superiority of the

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"Cotton Growing in Queensland," *Northern Whig* (Dec. 04, 1861): 4. The Wesleyan Methodist communities in Belfast followed the annexation investigation. "The Fiji Islands Declined by Britain," *Belfast News-Letter* (May 20, 1862): 4. Spurway, *Ma`afu, Prince of Tonga, Chief of Fiji*.

[31] W. J. Smythe, "Introduction," ii. On the impact of Smythe's ruling on annexation on the career of Pritchard, see Andrew E. Robson, "The Trial of Consul Pritchard," *The Journal of Pacific History* 30, no. 2 (Dec. 1995): 173-193.

[32] W. J. Smythe, "Introduction," ii. "Instructions addressed to Colonel Smythe, Royal Artillery, by his Grace the Duke of Newcastle, K.G.," in *Ten Months in the Fiji Islands*, 194.

[33] Ibid.

[34] Ibid.

[35] "Cotton from Australia," *Belfast Mercury* (Sep. 20, 1861): 4.

[36] "Cotton Supply," *Belfast Morning News* (Oct. 9, 1861): 3.

Fijian seeds over the Egyptian variety, establishing Fiji cotton as a viable alternative to the raw material sourced primarily from American southern states.[37] A book review in *Northern Whig* revealed the conflicted reception in Belfast of the news of Smythe's ruling against what had been anticipated as the inevitable annexation of the archipelago. The author noted the accomplishments of this "distinguished countryman" and wife from "one of the most respected families" in the town upon their return to Northern Ireland, despite the results that due to Smythe's unpopular decision the "hope of cotton supply, so largely and temptingly held out," was "abandoned."[38]

Sarah Maria Smythe's illustrations of Pacific coral reefs can be framed in the context of the reception of her husband's ruling against annexation, for Colonel Smythe included text from the Blue Book study in *Ten Months in the Fiji Islands*. Two years prior to the release of her 1864 publication, a scientific report on the botanical findings of the expedition offered documentation supporting the political process of annexation. Royal Botanic Gardens, Kew director William Hooker charged Berthold Seemann, a German botanist who began his studies at Kew in 1844, with the task of conducting a broad "botanical evaluation" of the archipelago during the Fijian exploratory survey's concurrent examination of the region for its suitability for growing cotton plants.[39] In Berthold Seemann's scientific opinion, Fiji remained a viable option for the production of the raw material and he promoted his case before the Victorian public. Seemann published his illustrated report *Viti: An Account of a Government Mission to the Vitian or*

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[37] "Cotton Growing in Queensland," *Northern Whig* (Dec. 04, 1861): 4.
[38] "Literary Notice," *Northern Whig* (Feb. 22, 1864): 4.
[39] W. J. Smythe, "Introduction," ii, iv-v. Legge, *Britain in Fiji*, 31-35. "Berthold Seeman," *Journal of Botany, British and Foreign* 10 (1872): 1.

Fijian Islands in the Years 1860-61 (1862) to circulate his argument in favor of the annexation of the region.[40]

The botanist admitted that "navigation of the central parts of the group, in the absence of a complete chart, [was] a rather difficult task."[41] Yet Seemann noted the benefits offered by the coral reefs surpassed the navigational risks as the inner reef regions, in specific geographic locations within the archipelago, provided accessible harbors. He advised that the southern island, for which Pritchard had recently completed a "rough survey," contained "deep water, good anchorage, and three passages through the reef outside, which acts as a natural breakwater" and a potential port for the larger mid-century vessels in transit to Victorian-era manufacturing centers in Great Britain.[42] As Kew botanist, Seemann had recognized Smythe's skill as an amateur botanical illustrator and published her work in his study of the natural resources of Fiji. Yet in the context of *Viti: An Account* (1862), Seemann incorporated one of her coral reef landscape illustrations as a chromolithograph in support of the argument for potential benefits from British investment in the region.[43]

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[40] Seemann, *Viti: An Account*, viii-ix.
[41] Seemann referred to the island Vanua Levu. Seemann, *Viti: An Account*, 141.
[42] Ibid.
[43] Seemann included Smythe's botanical illustration in the subsequent Kew publication *Flora Vitiensis*. Berthold Seemann, "Preface," in *Flora Vitiensis: A Description of the Plants of the Viti or Fiji Islands* i-iv (London: L. Reeve and Co., 1865-1873), iv, 254. Smythe received training in how to select plant samples prior to her arrival in Fiji but there is no record of her botanical contribution to the Kew collections. Smythe explained that while in New Zealand, "Dr. Sinclair, formerly Colonial Secretary, has kindly lent me a book on ferns." Sinclair offered the volume, Sarah Maria noted, "to guide me in making a collection for myself and *friends* when we get to Fiji." Smythe, *Ten Months in the Fiji Islands*, 5, Emphasis original. On Kew and colonial collectors, see Jim Endersby, *Imperial Nature: Joseph Hooker and the Practices of Victorian Science* (Chicago and London: University of Chicago Press, 2008), chapter 3.

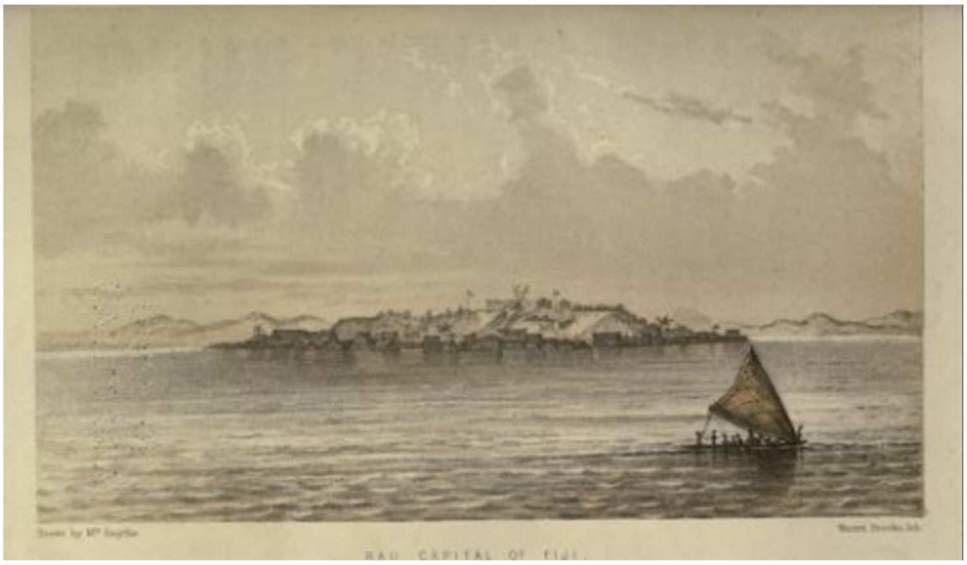

Figure 3.1. "Bau, Capital of Fiji. Drawn by Mrs. Smythe. Vincent Brooks, Lith." *Source*: *Viti: An Account* (1862), facing page 78.

"The annexed sketch, taken in 1860, by Mrs. Smythe, and kindly placed at my disposal, will give a better idea of the place than any description," Seemann observed, as her image depicted the free movement of indigenous vessels within the harbor in a region to which British residents lay claim.[44] Despite the scientific focus of *Viti: An Account*, the title page of this publication published by the Macmillan firm for general audiences associated this work with prior collaborative efforts between the author and the chromolithographer Vincent Brooks in popular volumes for mid-Victorian collectors of colonial ferns and plants.[45] The anticipated readership for *Viti: An Account*, released year after the British team's return from their imperial exploratory mission, extended beyond

[44] Seemann, *Viti: An Account*, 78. William Smythe noted that Viti Levu was one of the larger islands. "Two of the islands (Viti Levu and Vanua Levu) are of unusual size for the Pacific Ocean, having each a circumference of 250 miles." "Report of Colonel Smythe, R.A., to Colonial Office," in Seemann, *Viti: An Account*, 421-422.

[45] Berthold Seemann, *The Popular History of the Palms and their Allies* (London: Lovell Reeve, 1856). Brooks contributed to other volumes in the same series, for example Maria E. Catlow, *Popular Geography of Plants* (London: Lovell Reeve, 1855).

the scientific community such as the sponsors of the botanist's expedition and engaged with audiences who were stakeholders in colonial resource management.[46]

Sarah Maria Smythe's her collected letters in *Ten Months in the Fiji Islands* have been evaluated in support of research into the history of British political negotiations for annexation of Fiji.[47] Yet her volume also contained chromolithography executed by the firm of Vincent Brooks in which the commissioner's wife captured in her drawings "from nature" a perspective of the coral as structures facilitating the transit of British vessels. Brooks's signature application signaled to readers that Smythe's narrative published in 1864 depicted gaps in the architecture of specific Fijian reefs –at locations she interpreted using the British science of coral geology – in the context of imperial exploration and resource management.

Part 2 – "A Most Important Matter is a Trustworthy Interpreter."[48]

Sarah Maria Smythe's coral landscape drawings in her published volume *Ten Months in the Fiji Islands* (1864) visualized gaps in the Pacific tropical reefs and the impact of these openings on transit within the islands and among broader colonial

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[46] The German botanist had collaborated on projects with William Hooker and his son Joseph contributing to the expanding inventory of global natural resources. Berthold Seemann, *The Botany of the Voyage of H.M.S. Herald, Under the Command of Captain Henry Kellett, R.N., C.B., During the Years 1845-51* (London: Lovell Reeve, 1852), vii. The volume documenting the voyage also contained illustrations by Vincent Brooks. Michael Twyman, *A History of Chromolithography: Printed Colour For All* (London: British Library and New Castle, DE: Oak Knoll Press, 2013), 60, 69, 140 note 31. On the process of chromolithography, see Twyman, *A History of Chromolithography*, 125.

[47] Scholars cite *Ten Months in the Fiji Islands* in support of William Smythe's investigations into annexation. Spurway, *Ma`afu, Prince of Tonga*, chapter 6. Robson, "The Trial of Consul Pritchard," 173-193. Claudia Knapman briefly discussed Smythe's writings in the context of female Victorian-era correspondents' ethnographic observations communicated from Fiji. Knapman, *White Women in Fiji*, 1-2.

[48] Smythe, *Ten Months in the Fiji Islands*, 19.

regions.[49] Smythe noted the passages connecting the open ocean with the inner harbor regions of the Fijian islands in a set of chromolithographs based on sketches enclosed with letters to Belfast readers. Her published correspondence incorporating Darwin's coral growth theory, moreover, demonstrates an extension of Geological Society of London members' field research from the metropole to the "antipodes" in the hands of the general public.

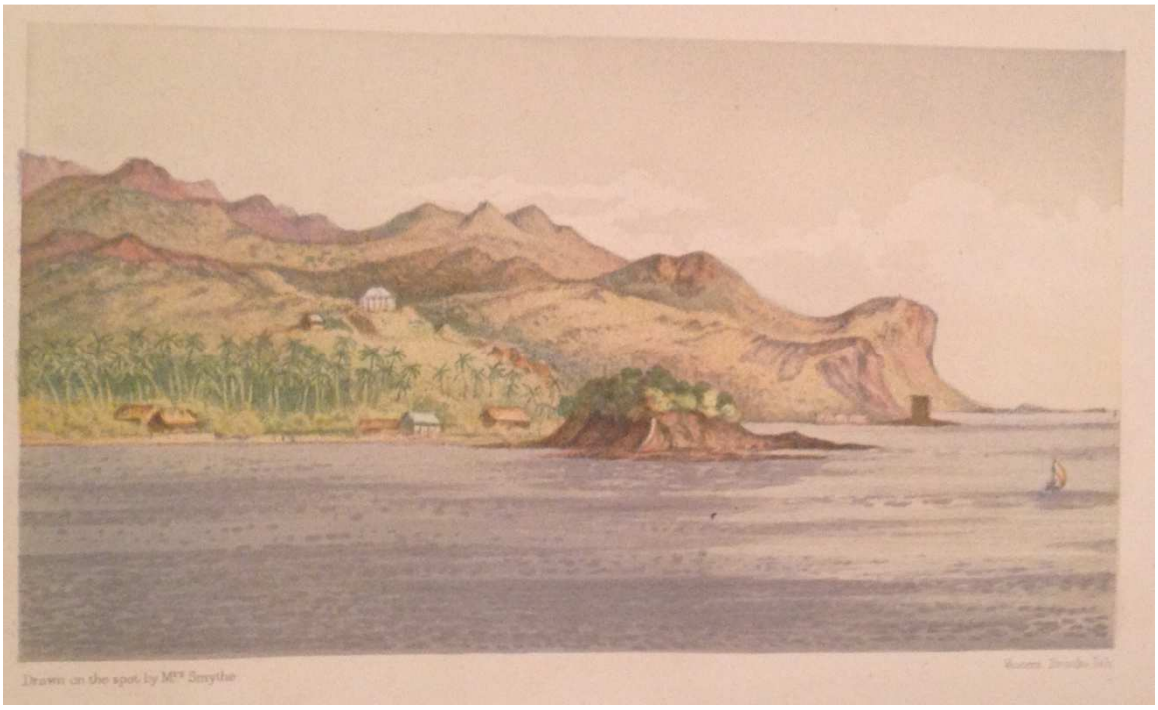

Figure 3.2. "Levuka (Island of Ovalau)," printed by Vincent Brooks, chromolithograph. *Source*: *Ten Months in the Fiji Islands*, Frontispiece.

Smythe's drawings depicting unique reef configurations in named locations in Fiji can be viewed in the context of her participation in the survey of the archipelago, engaging with

[49] Records for Sarah Maria's artistic training have not been located. Her older brother studied on the continent at the Parisian École des Beaux-Arts and "exhibit[ed] his work at the Royal Academy in London." Debbie Blake, *Daughters of Ireland: Pioneering Irish Women* (Dublin: The History Press Ireland, 2015), 139. Blake discussed Sarah Maria Smythe in the context of the biography of her niece and ward, the Edwardian-era Anglo-Irish aviatrix Lilian Bland. Based on Blake's research on the Bland family, it appears that Sarah was born after 1828.

what Ann B. Shteir has termed the "professionalizing turn within science culture" during the mid-Victorian era.[50] More broadly, within the collective message contained in her narratives and landscapes describing Pacific geography Smythe demonstrated that her evaluation of the reef architecture blurred disciplinary boundaries. While Smythe regarded visible colonial-region reefs as elements in the larger botanical landscape, the portion *under* the surface of the water was best interpreted within the science of geology. In other words, the Belfast author communicated first to her friends, and then to a wider cohort of readers via her published letters and accompanying chromolithographs, that she used geology to read the portion of the reefs *not* captured in her illustrations.

Traveling among the various islands within the Fiji archipelago with her husband William, Sarah Maria emphasized their reliance on a "trustworthy interpreter" as they completed a series of "public meetings at each important place, in order to ascertain the general feeling with respect to the cession of the Islands to England."[51] Yet Smythe functioned as an interpreter herself as she described the sections of coral that remained hidden from view. In one specific conversation in a letter home to friends in Belfast recorded within a week after landing at Levuka from New Zealand, Smythe documented her initial impressions of the Pacific Ocean archipelago and coral reefs. Writing during the summer of 1860 from Fiji, she observed that "[l]ooking at the outlines of Ovalau and the other islands in this portion of the group, we are much struck by their resemblance to the summits of submerged mountain chains rising abruptly from the sea" in the uncharted

[50] Ann B. Shteir, *Cultivating Women, Cultivating Science* (Baltimore and London: The Johns Hopkins University Press, 1996), 235. On the tensions between female botanical collectors and the rising professional class of botanists, see Shteir, *Cultivating Women*, 192.
[51] Smythe, *Ten Months in the Fiji Islands*, 19.

region of the archipelago.[52] "Possibly this appearance points to their true origin," she reasoned, as she wrote to friends about the history and formation of the surface openings in reef crucial to her husband's island travels during political negotiations.[53] This Levuka harbor reef, while not mapped, could be crossed with a degree of confidence because Darwin's geological theory predicted the three-dimensional configuration of the *gap* in the reef, a conduit between the Pacific and the island lagoon.[54]

Smythe related three aspects of the barrier coral reefs viewed from the vantage point of the elevated landing in the harbor. First, her letter interpreted current coral formations as growth in response to prior events. "Many of the coral reefs spring from a depth of several hundred fathoms," Smythe communicated to her Belfast community, "and at a considerable distance from the island shore which they encircle."[55] She explained the geological observation that coral growth occurred in shallow waters, and "[n]o coral-forming polyp, it has been ascertained, can live and work at a greater depth than thirty fathoms." Historic coral growth occurred as "the reef was built upwards" in response to the downward motion of the ocean floor.[56]

Next, Smythe inferred future growth rate based on Darwin's field research. She applied the "theory of the formation of the coral reefs, proposed by Darwin, [which] supposes a gradual sinking of the land," and she urged her readers consider contemporary

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[52] Smythe, *Ten Months in the Fiji Islands*, 21. William Smythe had noted in the 1860s that both coral atolls and volcanic islands comprise the more than three hundred islands in the Fiji archipelago. W. J. Smythe, "Colonel Smythe's Report," in *Ten Months in the Fiji Islands* (Oxford and London: John Henry and James Parker, 1864), 201. On the geography and geological history of Fiji, see for example Vincent E Neall and Steven A. Trewick, "The Age and Origin of the Pacific Islands: A Geological Overview," *Philosophical Transactions of the Royal Society London B: Biological Sciences* 363, no. 1508 (Oct. 27, 2008): 3292-3308, accessed May 11, 2016, doi: 10.1098/rstb.2008.0119.
[53] Smythe, *Ten Months in the Fiji Islands*, 21.
[54] Smythe, *Ten Months in the Fiji Islands*, 21-22. Charles Darwin, *Journal of Researches* (1845), 477.
[55] Smythe, *Ten Months in the Fiji Islands*, 22.
[56] Ibid.

reef construction as a process measured over time. As the geologist had recorded in *Journal of Researches*, alterations to the earth's crust were imperceptible, and "with intervals sufficiently long for the corals again to bring up their living edifices to the surface, must necessarily have been extremely slow."[57] In her narration, Smythe conveyed Darwin's key theme of a *persistent* and gradual transformation.

Smythe concluded with a discussion about the predictable absence of coral in specific locations. This author had observed this phenomenon during her own crossings through gaps in the barrier reef "exactly opposite those places on shore where streams of fresh water discharge themselves into the sea." She traced the origin of these "openings or passages" to a prior configuration, that of the historical geographic relationship between the island and its previous formation as a fringing reef. For Smythe, the contemporary crossing regions were in fact "left there at the first formation of the reef" when the coral structure was fabricated at a distance closer to the shore than visible to her own inspection in 1860.[58]

Sarah Maria Smythe noted to friends in Belfast that she was witness to nearly imperceptible environmental change, documented in specific geographic regions and measured as variation over time. In these written conversations, she applied the geological theory of constant forces over time to account for the origin of the passages in the distant past, in her words, "left there at the first formation of the reef."[59] Smythe's

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[57] Darwin, *Journal of Researches* (1845), 481.
[58] Smythe, *Ten Months in the Fiji Islands*, 21-22. Darwin discussed breeches in fringing reefs and barrier reefs. Darwin, *Coral Reefs* 66, 100. He used the term "narrow gateway" in *Journal of Researches*. Darwin, *Journal of Researches* (1845), 477. For prior theories to account for gaps in the reef, see for example Charles Lyell's text published the year Darwin addressed the London Geological Society, "The depth of the channels rarely exceeds twenty-five feet; and they may be attributed, says Captain Beechey, to the aversion of the lithophytes to fresh water." Charles Lyell, *Principles of Geology* 5th ed., vol. 3 (London: John Murray, 1837), 290.
[59] Smythe, *Ten Months in the Fiji Islands*, 21-22.

reading of the individual reef openings disclosed the general audience's conceptualization of contemporary geological arguments. Charles Lyell had cited both Darwin's scientific publication *Coral Reefs* and popular edition of *Journal of Researches* (1845) in his 1847 edition of *Principles of Geology*, in which he had explained the primary formation of a "deep and narrow passage opening into the lagoon."[60] Lyell insisted that the "origin of this channel must, according to the theory of subsidence before explained, be traced back to causes which were in action during the existence of the encircling reef."[61] Smythe's passage suggests the Belfast reading community's familiarity with the name "Darwin" during the months coinciding with the publication of *On the Origin of Species* in the context of his reef theory and the value of coral growth measurements in the quantification of environmental change over time.

Illustrations of the relationship between the gap in the reefs and the inclusion of the indigenous sailing vessel, first published in Seemann's *Viti: An Account* and repeated throughout the color plates in her own collection of letters, supported Smythe's reading of geological theory in the context of colonial endeavors. Landscape drawings of coral reefs in *Ten Months in the Fiji Islands* (1864) incorporated chromolithography by the celebrated Vincent Brooks and which clearly connected Smythe's work to a genre of publications documenting the process of cataloguing imperial natural resources. For this Victorian British official's wife, Darwin's theory of geological forces functioned as a practical tool – a "trustworthy interpreter" – as well as a colonial field guide with which to assess the impact of reefs on the outcome of the British government mission to evaluate the annexation of Fiji.

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[60] Charles Lyell, *Principles of Geology* (1847), 761.
[61] Ibid.

Smythe explained to her readers that she intended to capture on paper what she identified as a "sketch from nature," a faithful rendering of the landscape viewed from her position inside a crudely constructed Kew-sponsored scientific observatory on the Fijian island of Levuka.[62]

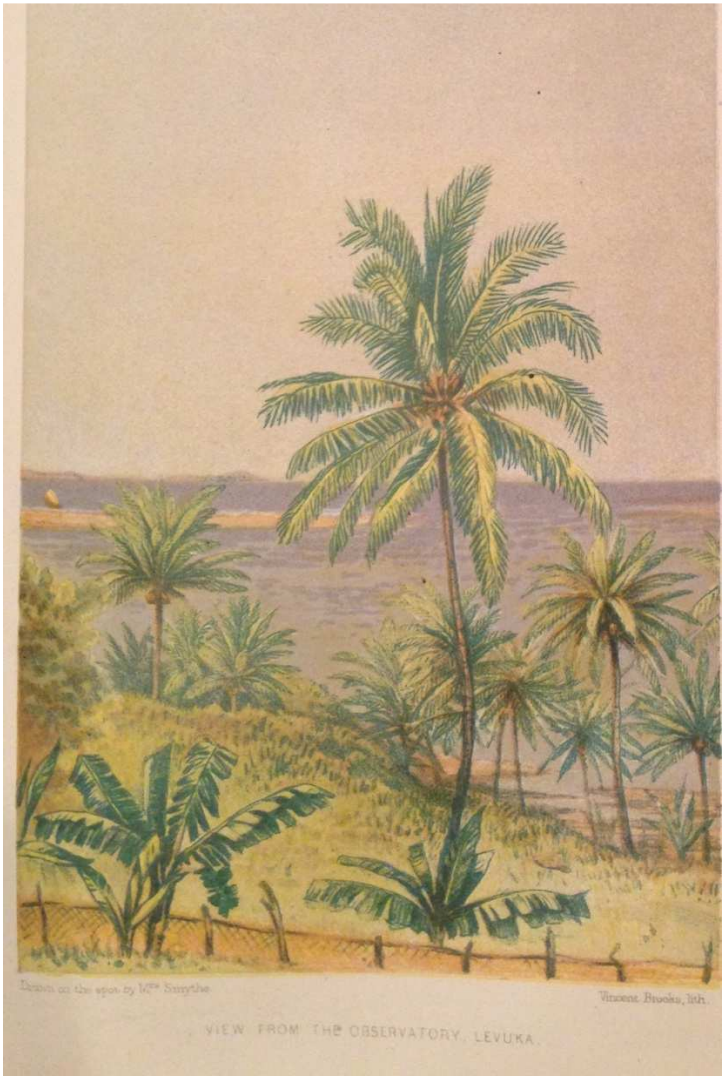

Figure 3.3. "View from the Observatory, Levuka," printed by Vincent Brooks, chromolithograph. *Source*: *Ten Months in the Fiji Islands*, facing page 144.

[62] Sarah Maria recorded that assisted her husband as he conducted "magnetical observations. I have also had a little to do as assistant observer, having learned to read the pocket chronometer to the decimals of a second." Smythe, *Ten Months in the Fiji Islands*, 148. On the construction of the observatory, see Smythe, *Ten Months in the Fiji Islands*, 23.

Figure 3.4. "View from the Observatory, Levuka," printed by Vincent Brooks, chromolithograph. *Source*: *Ten Months in the Fiji Islands*, facing page 144 (detail).

"I have seated myself to write to you," she began, and proceeded to describe the reef's varying hues viewed from the harbor.

> "[A]s this is intended for a sketch from nature, I can't put in what I myself don't see. I will attempt this view in water-colours, but I fear I shall never be able to do justice to the reef."[63]

Smythe focused, moreover, on the "passage through" the encircling reef, marked by the positioning of the indigenous vessel outside of the inner reef region after its traverse through the gap "which is clearly distinguished by the deep blue sea interrupting the breakers on either side."[64] Smythe's sketch of this specific reef captured the focus of the

[63] Smythe, *Ten Months in the Fiji Islands*, 145.
[64] Smythe, *Ten Months in the Fiji Islands*, 144.

mid-Victorian era imperial mission. "Mrs. Smythe was making a water-colour drawing of the Levuka reef," botanist Seemann later recalled, which "displays itself in all its grandeur, and together with the little islands at a distance, and the shipping of the port, forms a panorama not easily matched."[65] Smythe viewed and faithfully recorded, from her vantage point within the British scientific structure designed to record magnetical readings, evidence of the potential for commerce signaled by the existing port in the inner reef harbor.

A second chromolithograph focused on the reef alone as a region marked for future development. While the island itself "has little natural beauty," Smythe explained in her description of the geographically smaller region of Lakemba, "the reef which surrounds it is the finest we have yet seen."[66]

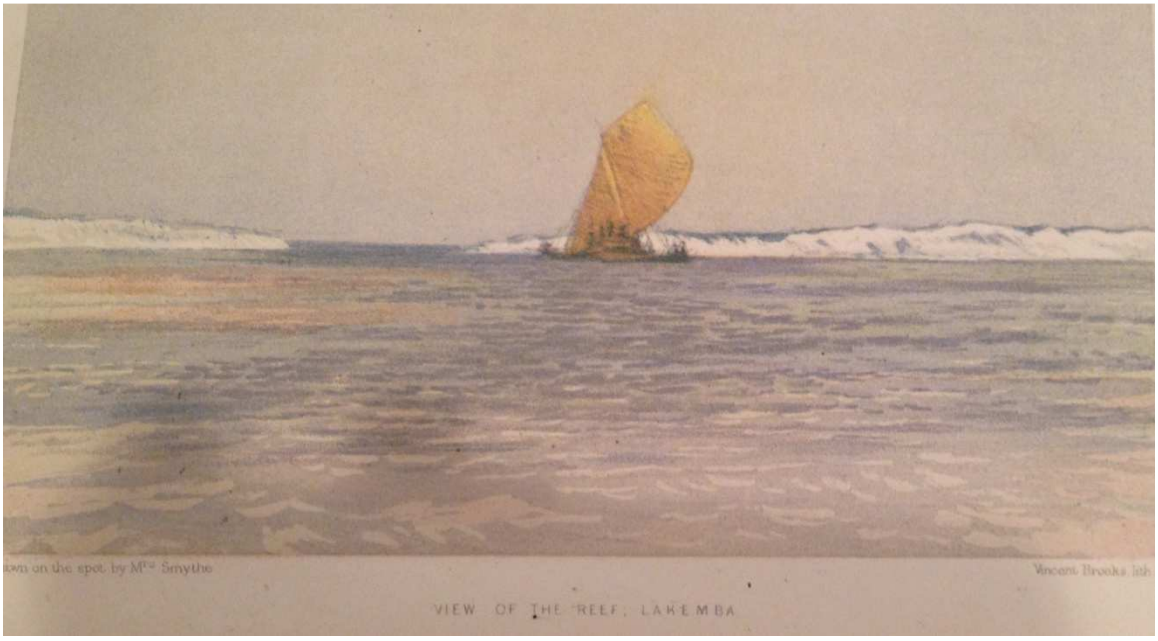

Figure 3.5. "View of the Reef, Lakemba," printed by Vincent Brooks, chromolithograph. *Source*: *Ten Months in the Fiji Islands*, facing page 129 (detail).

[65] Seemann, *Viti: An Account*, 120.
[66] Smythe, *Ten Months in the Fiji Islands*, 129. Lakemba was the site of the first Wesleyan Methodist missionary settlement in 1835. Smythe, *Ten Months in the Fiji Islands*, 20.

Here, she sketched the illustration not from an island but while on board a vessel "at anchor within the bay" of the inner harbor.[67] She indicated the passage through the coral architecture as the absence of the activity of the "great waves approaching and striking the reef."[68] The craft is reflected in the lagoon water as it approaches the opening between the inner region and the ocean waters. Smythe pictured Pacific reefs for British readers as landscapes in motion, the inner lagoon region and ocean waters linked through the action of subsidence over time.

The inclusion of the process of chromolithography in *Ten Months in the Fiji Islands* reframes her volume in the context of the Kew scientific exploration within political landscapes. It is significant that approximately one-third of the illustrations in Sarah Maria Smythe's own volume *Ten Months in the Fiji Islands* were printed using chromolithography provided by the London lithographer Vincent Brooks, who produced plates for both scientific publications and works marketed towards the upper-middle classes during the prior decade.[69] Taken together, Smythe's illustrations published in *Viti* and *Ten Months in the Fiji Islands* were chromolithographs that conveyed coral reef scenery and landscapes encountered during the conduct of imperial exploration. More broadly, these images signaled an identifiable colonial framework with which to interpret

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[67] Smythe, *Ten Months in the Fiji Islands*, 129.
[68] Ibid. Contrast this vessel with Smythe' rendering of British ships. Smythe, *Ten Months in the Fiji Islands*, 9.
[69] Of the thirteen illustrations, four were identified as chromolithographs. "List of Illustrations," page xii. Brooks produced chromolithographs of Joseph Hooker's works during the 1850s. Twyman, *A History of Chromolithography*, 60, 69, 140 note 31. During the production of Seemann's volume *Viti*, Brooks had been awarded a medal at 1862 London exhibition. Seemann published after the International Exhibition of 1862. Seemann, *Viti*, 57. On Brooks's international awards, see Twyman, *A History of Chromolithography*, 169-170. As Michael Twyman has noted, Brooks previously exhibited at London's 1851 Crystal Palace Exhibition, an event at which "the first significant public exposure of colour printing" occurred. Twyman, *A History of Chromolithography*, 125, 169. *Art-Journal* had recognized his skills and accomplishments. "Lithographic Printing," in "Minor Topics of the Month," *The Art-Journal* (Oct. 1, 1853): 267.

illustrations accompanying the collected letters. In three works colored by Brooks – the image of Bau in the larger island of Viti Levu in Seemann's *Viti*, and the views of the reefs at Lakemba and Levuka, Smythe portrayed an indigenous ship and the breach in the coral reef. In this context, the positioning of the Fijian vessel was scientific, not ethnographic. Sarah Maria Smythe's focused attention to the intersection of the architecture of the reef environment with the mechanics of its crossing was consistent with her drive to precisely execute the scenes of the coral reef passages she encountered in Fiji, in a manner which Knapman has categorized as a "realist reading" of the experiences of Western women as they interpreted their engagements with colonial regions.[70] The landscape of the Fijian reef juxtaposed with the vessel portrayed the indigenous population and their knowledge of the reef crossing which signified the potential for Fiji to advance the British national interests in both imperial data collection and security as a military presence in the midst of the Pacific. Smythe depicted the scene not as a passive landscape sketch but as a rendition of the action of reef crossing made possible through, as she argued, unseen geological forces.

Discussion – Mrs. Smythe Reads Mr. Darwin

For Sarah Maria Smythe, Charles Darwin's coral reef theory promised predictable gaps in the reefs for safe crossing. She conveyed to family and acquaintances, as *On the Origin of Species* came to press, of her confidence in her ability to identify and quantify

[70] Claudia Knapman has argued that correspondents recognized autobiographical accounts as faithful renditions of authors' experience. Knapman, "Western Women's Travel Writing about the Pacific Islands," 33-34. Knapman drew on Sara Mills's historiography of the study of Western women's Pacific region travel narratives, identifying categories of scholarly analysis including realist, proto-feminist, and orientalist. Sara Mills, *Discourses of Difference: An Analysis of Women's Travel Writing and Colonialism* (London and New York: Routledge, 1991) referenced in Knapman, "Western Women's Travel Writing," 33.

minute, incremental – and inevitable – environmental change, skills stressed in Darwin's field research and circulated to the general readers in Geological Society of London members' publications throughout the preceding decades. This close reading of the geological context of Smythe's letters published in *Ten Months in the Fiji Islands* (1864) argues for an evaluation of the impact of the public education in theoretical and practical geology, in particular Darwin's coral growth subsidence theory, on the Victorian reading of natural selection. As Kimberly Hamlin has recently argued in *From Eve to Evolution*, concurrent with the public debates regarding *Origin of Species*, late Victorian-era feminists "were drawn to evolutionary theory because it naturalized a world based on variation and change."[71] Smythe's correspondence as an amateur participant in colonial natural history data collection compels us to consider the impact of the content of Geological Society members' didactic materials and lectures, critical sources promoting Darwin's coral growth theory, that likewise served to "naturalize" environmental variability, *before* readers engaged in debates regarding natural selection. The recipients of her letters were not indicated in her correspondence. Scant biographical data situate Sarah Maria's life prior to her travels to Fiji within a middle-class family in Belfast and contextualize the author's young adult life within specific religious, artistic, and political spheres in what Christine Kinealy and Gerard Mac Atasney have termed "one of the most industrialized and prosperous areas of Ireland" mid-century.[72]

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[71] Hamlin's full text reads, "The nineteenth-century feminists studied in *From Eve to Evolution* were drawn to evolutionary theory because it naturalized a world based on variation and change, established a line of continuity between animals and humans, and probed the boundaries between nature and culture and because they, too, saw in it the potential for nonessentialist, nonreductive accounts of sex difference." Kimberly A. Hamlin, *From Eve to Evolution: Darwin, Science, and Women's Rights in Gilded Age America* (Chicago: University of Chicago Press, 2014), 18.

[72] Christine Kinealy and Gerard Mac Atasney, *The Hidden Famine: Poverty, Hunger and Sectarianism in Belfast 1840-1850* (London and Sterling, VA: Pluto Press, 2000), 4. Newspaper accounts of court records

Smythe's correspondence conveyed that while in Fiji, she moved freely within a broader colonial scientific sphere which was valued among her mid-century Northern Ireland cohort inscribed by her family's position as middle-class Belfast Protestant merchants and professionals. She conveyed to her readers the names and identities of a variety of British men of science, evidence of a personal engagement with researchers and interests as an amateur illustrator of scenes "from nature" independent of her husband's political assignment.[73] Her letters suggest as well that readers would recognize the importance of these connections. For example, Smythe explained that while in New Zealand, "Dr. Sinclair, formerly Colonial Secretary, has kindly lent me a book on ferns."[74] While Ann B. Shteir has noted that "[c]olonial wives were enlisted in projects for imperial botany," Smythe was not asked to contribute to the Kew collections; rather, Sinclair's book was "to guide me in making a collection for myself and *friends* when we get to Fiji."[75] Shteir's case study of a female British collector whose "family naval connections provided her with a steady supply of exotic specimens" from imperial military outposts offers a framework in which to evaluate Smythe's correspondence.[76] Thus it is likely, based on Smythe's emphasis on the word "*friends*," the author's readers enlisted her to acquire specimens during her time in the Pacific, and throughout Smythe

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indicate that the Bland household contained as well two unmarried aunts who owned property in Belfast with Rev. Bland as late as 1848. "In the Equity Exchequer," *Belfast Newsletter* (Dec. 15, 1848): 3.

[73] Smythe, *Ten Months in the Fiji Islands*, 145.

[74] Smythe, *Ten Months in the Fiji Islands*, 5. Brian P. J. Molloy, "Sinclair, Andrew," *Dictionary of New Zealand Biography. Te Ara - the Encyclopedia of New Zealand*, updated 18-Feb-2014 URL: http://www.TeAra.govt.nz/en/biographies/1s12/sinclair-andrew.

[75] Shteir, *Cultivating Women*, 192. Smythe, *Ten Months in the Fiji Islands*, 5. Emphasis original. On Kew and colonial collectors, see for example Jim Endersby, *Imperial Nature: Joseph Hooker and the Practices of Victorian Science* (Chicago and London: University of Chicago Press, 2008), chapter 3.

[76] Shteir, *Cultivating Women*, 186.

discussed preserving and packaging objects to forward ahead to recipients in Britain.[77] Marc Serge Rivière has noted the active trade in nineteenth-century botanical specimens between colonial regions and Kew that filtered through Belfast institutions including the Botanical Gardens.[78] These references to Sinclair, as well as Kew botanist Seemann, are significant because they reveal that her social circle was attentive and informed about infrastructure surrounding the labor of collecting colonial objects of natural history.

Yet Smythe was also witness to nearly imperceptible environmental changes, varying not over geographic region but over time. She measured these small shifts using indirect calculations, inferring three aspects of Pacific region coral reef growth based on Darwin's theory. This is significant because she was not theorizing herself, but used Darwin's arguments to explain her own observations. For this colonial official's wife, Darwin's theory functioned as a practical guide and field source for information about measurements of coral reef growth. While Sarah Maria Smythe's adventures and biography warrant further scholarship, more broadly, the coral reefs narratives present an opportunity to respond to Evelleen Richards's invitation to "locate individual Victorian women in precise relation to the wider sociopolitical contexts of Darwinian science and its practitioners."[79] Scholars have focused on women writers' engagement with Darwin's texts following the publication of *The Origin of Species* (1859) and *The Descent of Man, and Selection in Relation to Sex* (1871).[80] As this chapter has demonstrated, however,

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[77] Smythe collected insects as well, packed for shipment to Britain. Smythe, *Ten Months in the Fiji Islands*, 145.
[78] Rivière, "From Belfast to Mauritius," 133, 137.
[79] Evelleen Richards, "Redrawing the boundaries: Darwinian Science and Victorian Women Intellectuals," in *Victorian Science in Context*, ed. Bernard Lightman, 119-142 (Chicago: The University of Chicago Press, 1997), 119-120.
[80] See for example, Rosemary Jann, "Revising the Descent of Woman: Eliza Burt Gamble," in *Natural Eloquence: Women Reinscribe Science*, ed. Barbara T. Gates and Ann B. Shteir, 147-163 (Madison, WI: The University of Wisconsin Press, 1997); Hamlin, *From Eve to Evolution*. Barbara T. Gates, *Kindred*

prior to the publication of these works, Victorian-era female authors were situated within an intellectual sphere that identified Darwin with idea that environmental change – measured geologically – was inevitable.

Finally, it is important to integrate the timeline of Smythe's correspondence from Fiji with the circulation of Darwin's name in Ireland. John Murray published *Origin of Species* on November 24, 1859. By December, less than one month later, quotes from Darwin's text appeared in a biography in the *Irish Examiner*, describing one man's rise to "fortune and fame," not by birth "but by the force of strong talents and his engaging personal qualities," as invoking "what Darwin calls, the universal 'struggle for existence'."[81] On January 16, 1860, the day Colonel and Mrs. Smythe departed for Fiji, newspapers advertised that Irish circulating libraries obtained Darwin's book.[82] Sarah Maria Smythe not only wrote letters, but received them as well during her time in the Pacific.[83] In this context, then, *Ten Months in the Fiji Islands* can be read not as an epistle but rather as a conversation between middle class correspondents. While this chapter has focused on her intention as she wrote regarding Darwin and geology in the summer of 1860, Smythe's incoming mail was not documented in her book and it is plausible that Darwin was discussed in these exchanges. Smythe's letter regarding

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Nature: Victorian and Edwardian Women Embrace the Living World (Chicago: University of Chicago Press, 1998), chapter 2. Evelleen Richards, "Darwin and the Descent of Woman," in *The Wider Domain of Evolutionary Thought*, ed. D. Oldroyd and J. Langham, 57-111 (Dordrecht: D. Riedel, 1983). See also "Women as a Scientific Audience," Darwin Correspondence Project, Cambridge University Library, accessed July 15, 2016. https://www.darwinproject.ac.uk/learning/universities/women-and-science/women-scientific-audience.

[81] "M. Mocquard," *Irish Examiner* (Dec. 19, 1859): 3. On Mocquard, "the Emperor's secretary," "oldest supporters" of the "Bonaparte family," see "Our Paris Correspondent," *The Ladies' Companion and Monthly Magazine* second series, XXVII (1865): 51.

[82] "Morrow's Public Library, Nassau-Street," *Freemans Journal* (Jan. 16, 1860): 2. Also "Dublin Library Society," *Freemans Journal* (Feb. 7, 1860): 1. According to William Smythe, the two departed from London on January 16, 1860. William Smythe, "Introduction," v.

[83] Smythe, *Ten Months in the Fiji Islands*, 143, 144.

Darwin was dated July12, 1860, at the same time that periodicals publicized the "animated discussion on Mr. Darwin's theory" by Samuel Wilberforce, Bishop of Oxford and "Professor Huxley," who "just as earnestly supported" Darwin.[84] As Smythe explained, mail delivery took two months, suggesting that her letter discussing coral reef growth was most likely received in the fall of 1860, a period when, the *Belfast Newsletter* reported, Darwin's book was "the subject of warm debate in the scientific world."[85]

Mary Louise Pratt's analysis of women travelers to colonial regions offers a framework for evaluating Smythe's expressions of her facility with botanical, magnetical, and coral reef growth measurements in Fiji during the mid-Victorian-era. In *Imperial Eyes: Travel Writing and Transculturation*, Pratt, following Marie-Claire Hoock-Demarle, examined the writings of "urban middle-class women in the early nineteenth century" as they traveled to colonial "sites of social management and control."[86] Two rhetorical devices characterized the writings of these "social exploratress."[87] First, the female authors' rhetoric described their own experiences learning about unfamiliar technical processes, such as sugar refineries and "artisanal pottery works" in "a language that is explanatory but non-technical."[88] Next, the descriptions revealed an author who "presents herself as acquiring knowledge in a participatory fashion," writing in a manner "constructs and idealizes herself as an aggressive, interactive seeker of knowledge."[89] Similarly, Smythe described not only coral reef growth but also ways in which to record colonial botanical and magnetic observations in a manner that was assertive and

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[84] "Summary: Foreign and Home," *Tralee Chronicle and Killarney Echo* (July 6, 1860): 2.
[85] The article discussed American Asa Gray's rebuttal to Darwin. "Fine Arts and Literature," *Belfast Newsletter* (Nov. 13, 1860): 4.
[86] Mary Louise Pratt, *Imperial Eyes: Travel Writing and Transculturation* (London: Routledge, 1992), 160.
[87] Pratt, *Imperial Eyes*, noted in Shteir, *Cultivating Women*, 191-192.
[88] Pratt, *Imperial Eyes*, 161-163.
[89] Pratt, *Imperial Eyes*, 163.

confident. However, unlike the "oppositional" position taken by female authors in Pratt's study, in which the writer expressed a subservient or "infantile" posture that stood in marked contrast to the "patriarchal" narratives, Smythe conveyed that she was a collaborator in British scientific methodology applied in this Pacific region.

Framing Smythe's Fiji experience in light of her functioning as a narrator of her collaborative mid-Victorian-era colonial scientific experiences places Smythe's application of Darwin's coral reef theory in a specific light. While Smythe considered Darwin's theory useful for quantifying nature, she integrated his observations with others in a mid-Victorian era toolkit for the experience of natural history in a colonial environment. Documenting coral growth, collecting and classifying ferns, and quantifying magnetical reading within the pre-colonial laboratory that was Fiji, Smythe quantified her Pacific Island experience. Smythe used geological methodology at a time when Geological Society of London and Geological Survey members consciously educated the public, using charts, diagrams, and texts, about coral growth incorporating concrete examples in geographically specific locations. Smythe likewise explained for her first audience, her friends in Belfast, a town in Northern Ireland which, as Jonathan Jeffrey Wright has noted, considered itself "part of the metropolitan centre, rather than the colonial periphery" and integral to the expanding imperial network of the mid-nineteenth century, that the coral reef configurations in Bau, Lakemba, and Levuka supported Darwin's geological theory.[90] *Ten Months in the Fiji Islands* stands as a demonstration of the public application of the framework presented in publications

[90] Wright, "'A Depot for the Productions of the Four Quarters of the Globe': Empire, Collecting and the Belfast Museum," 147. Ruth Margaret Bowman Bayles, "The Belfast Natural History Society in the Nineteenth Century: A Communication Hub," in *Belfast: The Emerging City, 1850-1914* ed. Olwen Purdue (Dublin: Irish Academic Press, 2013).

evaluated in the first section of this project, namely, that of the general readers' acceptance of the relevance of the study of geological coral growth in advancing British interests in domestic and global scientific, economic, and political spheres.

During the same decades, the galleries of London's 1851 and 1862 International Exhibitions functioned as an additional site for geological field study. Exhibition guides supplemented British field books in the education of the public in how to evaluate coral on display in Britain. Here, too, authors invoked specific geographies to explain the impact of environment conditions on coral growth. Robert Hunt, geologist and exhibition commissioner, evaluated these distinctions in a series of guides discussing unpolished coral branches. In the next chapter, I situate the way in which exhibition texts were evidence of how Victorians engaged with geology to frame coral as a national resource.

CHAPTER 4

Hunt's Hand-book: Coral at London's International Exhibitions, 1851-1862

London's International Exhibition halls provided the general public opportunities to investigate and evaluate coral collections. The Victorian-era guidebooks assessed in this chapter, published for both the 1851 Great Exhibition of the Works of Industry of All Nations, or Crystal Palace, and the subsequent 1862 International Exhibition, framed raw or unpolished coral displayed in these public spaces in the context of ongoing Geological Society of London field research narratives. I demonstrate that Robert Hunt, Keeper of Mining Records with the Museum of Practical Geology, authored guidebooks which extended the scope of British geological research from evaluations of domestic and colonial resources to encompass studies of coral sourced from Mediterranean waters.[1] Hunt had "sought to improve his finances, his career prospects and his standing in the scientific community by contributing to several periodicals," noted Geoffrey Cantor, and "[h]is appointment in 1845 as keeper of the Mining Records Office, which formed part of the Geological Survey, redirected his research towards mineralogy."[2] Hunt explicitly mapped the location of international contributions of coral displayed in the foreign and colonial galleries of London's 1851 and 1862 International Exhibition. He also discussed the Mediterranean coral branches viewed in the Centre Transept of the British gallery

[1] On the Geological Survey outreach to the general public, see chapter 2 in this present work. On the professionalism of the Survey, see Secord, "The Geological Survey of Great Britain as a Research School, 1839-1855," 232-233. The Museum of Practical Geology moved to Picadilly, London in 1851. G. W. Roderick and M. D. Stephens, "Mining Education in England and Wales in the Second Half of the Nineteenth Century," *The Irish Journal of Education / Iris Eireannach an Oideachais*, 6, no. 2 (1972): 108. The museum relocation coincided with the opening of the Crystal Palace Exhibition.

[2] Cantor, "Guides to the Exhibition and Other Material Addressed to Visitors," 33. James Secord, "The Geological Survey of Great Britain as a Research School, 1839-1855," *History of Science* (1986): 228-229, 255.

which showcased imperial gems extracted from global colonial regions. Hunt's narratives are situated in the context of the gallery installation schemes and his geological appraisal of displayed coral branches as exhibition commissioner.

Aileen Fyfe's scholarship on coral exhibited at the British Museum during the 1840s, one decade prior to the 1851 Crystal Palace exhibition, offers a useful framework with which to evaluate accounts describing samples of coral on view in these galleries. For Fyfe, early nineteenth century museum guide authors recognized that visitors "did not view its exhibits in isolation."[3] Rather, Fyfe identified two powerful influences circulating in missionary and navigators' narratives during the 1840s, and situated interpretative texts explaining coral exhibits to museum viewers in the context of such third-party interpretations, such as an "article on the wonders of marine life," or "reproduction of a painting of Cook in Australia."[4] As this project has documented, Geological Society of London members' public outreach in publications including *Penny Magazine* represented a third and concurrent interpretative influence. This chapter demonstrates that their messages, too, impacted exhibition guide entries describing coral on display, with new applications of prevailing narratives conveying that coral grew in response to geological forces resulting in environmental change.

Contemporary Robert Chambers later commented on the challenges facing Victorian authors wishing to categorize or classify carved coral ornaments within the framework of British jewelry. In the article "Gems of the Sea," *Chambers's Journal of Popular Literature, Science and Arts* explained that "[e]ven jewellers are not quite agreed

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[3] Aileen Fyfe, "Reading Natural History at the British Museum and the *Pictorial Museum*," in *Science in the Marketplace: Nineteenth-Century Sites and Experiences*, eds. Aileen Fyfe and Bernard Lightman (Chicago: University of Chicago Press, 2007), 217.
[4] Ibid.

as to the class in which this substance ought to be placed. Is it a precious stone? Is it a gem? If not, what is it, in a decorative point of view?"[5] Historians have noted coral jewelry displayed at London international exhibitions on 1851 and 1862, years coinciding with the popularity of ornamental coral in Britain beginning in the mid-1840s and lasting through 1860s.[6] Jewelry historian Judy Rudoe briefly commented that the 1851 issue of *The Illustrated London News* alerted readers that the southern Mediterranean region of Naples contributed polished "branch coral, especially favoured for tiaras," and carved coral cameos displayed in the "British section" by a London importer.[7] Absent from historical studies, however, are International Exhibition descriptions of displays of raw or unpolished coral branches. These exhibits were viewed during the coral jewelry craze in Britain, yet these spectacles also coincided with the promotion and reception of geological arguments regarding local and global coral growth among the general Victorian public both before and during the international events.

I first analyze guides including *Hunt's Hand-Book* (1851), Hunt's *Synopsis of the Contents of the Great Exhibition of 1851*, and his *Handbook to the Industrial Department of the International Exhibition, 1862*.[8] Clearly, among the one hundred thousand exhibits installed in what *Routledge's Guide* termed the "crystal mazes" the samples of global

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[5] "Gems of the Sea," *Chambers's Journal of Popular Literature, Science and Arts* (May 21, 1870): 325.
[6] Katharine Anderson, "Coral Jewellery," *Victorian Review* 34, no. 1 (Spring 2008): 47-48. On Victorian-era coral jewelry, see for example Charlotte Geer and Judith Rudoe, *Jewellery in the Age of Queen Victoria: A Mirror to the World* (London: British Museum Press, 2010).
[7] Judy Rudoe, "Jewellery at the Great Exhibition," in *Die Weltausstellung von 1851 und ihre Folgen / The Great Exhibition and its Legacy*, ed. Franz Bosbach and John R. Davis (Müchen: K. G. Saur, 2002), 73, 74 note 23. Geer and Rudoe, *Jewellery in the Age of Queen Victoria*.
[8] In her critique of historical scholarship on contemporary Great Exhibition narratives, Louise Purbrick observed that "[e]xhibit accounts have tended to be neglected by historians because the amount of detail, often technical, they present about individual exhibits seems disproportionate to that object's importance within the Crystal Palace and thus unrepresentative of any overall meaning of the Great Exhibition." Louise Purbrick, "Defining Nation: Ireland at the Great Exhibition of 1851," in *Britain, the Empire, and the World at the Great Exhibition of 1851*, ed. Jeffrey A. Auerbach and Peter H. Hoffenberg (Aldershot and Burlington, VT: Ashgate Publishing, 2008), 61.

coral would appear insignificant.[9] Yet digital searches of archival commemorative and ephemeral contemporary guidebooks document multiple narratives which mapped the location of exhibited coral for Crystal Palace visitors. A close reading of Hunt's *Art-Journal* (1860) article follows, in which he presents his argument for viewing London jeweler Robert Phillips's curated collection of raw or unpolished coral in the context of the science of geology, rather than that of the decorative arts. This chapter concludes with an article from the satirical periodical *Punch*, which documents how within the 1862 International Exhibition descriptions of publically displayed coral branches, authors viewed Phillips's Mediterranean coral exhibited in the British Centre Transept not in intellectual isolation, but with an imperial lens and a geological eye.

Part 1 – Geological Guides to Colonial and Foreign Coral, 1851

Visitors exploring the 1851 gallery spaces witnessed hundreds of examples of geological resources extracted through the efforts of miners and researches alike, providing physical evidence supporting Geological Society of London members' sustained efforts to offer instruction in both methodology and theory.[10] The practitioners' outreach to general audiences since the 1830s and into the late 1840s, during the decades leading to the planning of the Crystal Palace event, spanned class and gender. Geologist Gideon Mantell lectured frequently on the topic of coral geology in mid-nineteenth

[9] "Preface," in *A Guide to the Great Exhibition; Containing a Description of Every Principal Object of Interest. With a Plan, Pointing out the Easiest and Most Systematic Way of Examining the Contents of the Crystal Palace* (London: George Routledge and Co., 1851), iv. Also Edward MacDermott, *Routledge's Guide to the Crystal Palace and Park at Sydenham* (London and New York: George Routledge & Co, 1854), vi.

[10] Adelene Buckland placed the number of geological exhibits at nearly 600, based on catalogue entries. Adelene Buckland, "'The Poetry of Science': Charles Dickens, Geology, and Visual and Material Culture in Victorian London," *Victorian Literature and Culture* 35, no. 2 (2007): 683.

century Britain, and noted in his diary audience responses to his speaking engagements which documents the demographics of Victorians participating in conversations about contemporary geological research concurrent with the Crystal Palace event.[11] In his entry for a talk during London's Great Exhibition, at a location near the recently opened gallery spaces, Mantell recorded his reactions to what he considered an extraordinary demonstration of public enthusiasm for coral geology.

> Delivered a lecture on Corals and Coral Islands at Kensington: 200 persons present! which I was astonished at, for the Exhibition engrosses everybody, but disarranges everything; it has literally driven all the London world mad![12]

Earlier that year, Mantell had addressed a large number of attentive listeners at the Whittington Club, an "experiment in social reform," as Christopher Kent noted, "designed to bring the advantages of club life out of the West End and extend them to the lower middle class clerks and shop assistants," and to the "doubly precarious situation of independent women in that class."[13] A contemporary guidebook noted that Salisbury's Mechanics' Institute members attended regularly scheduled lectures in the town's Assembly Rooms.[14] An audience of nearly five hundred at that venue received Mantell's coral address, he recalled, with "very enthusiastic applause."[15] This seasoned and

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[11] Dennis R. Dean, *Gideon Algernon Mantell: A Bibliography with Supplementary Essays* (Delmar, NY: Scholars' Facsimiles and Reprints, 1998).
[12] Mantell, *The Journal of Gideon Mantell Surgeon and Geologist* and *The Unpublished Journal of Gideon Mantell 1819-1852* quoted in *The Great Exhibition: A Documentary History*, ed. Geoffrey Cantor, vol. 3 (London: Pickering & Chatto, 2013), 309.
[13] Gideon Mantell, *The Unpublished Journal of Gideon Mantell 1819-1852*, ed. John A. Cooper (Brighton and Hove, UK: The Royal Pavilion & Museums, 2010), 150. Christopher Kent, "The Whittington Club: A Bohemian Experiment in Middle Class Social Reform," *Victorian Studies* 18, no. 1 (Sept., 1974): 31.
[14] J. B. Moore, *Brown's Stranger's Handbook and Illustrated Guide to the City Of Salisbury: Or, an Account, Historical and Descriptive of the Objects of Interest in Salisbury & its Neighborhood* (Salisbury, England: Brown & Co., 1857), 74.
[15] Gideon Mantell, *The Journal of Gideon Mantell Surgeon and Geologist,* ed. E. Cecil Curwen (Oxford: Oxford University Press, 1940), 264.

popular lecturer revealed his amazement at the attention directed towards the geological aspects of coral growth in the midst of the planning and installation of the international spectacle and its display of global goods.

It is not surprising that Mantell anticipated that the Crystal Palace event would compete for the attention of his middle- and working-class audiences. The geologist had recorded in his journal his *own* multiple visits to the exhibition.[16] Yet these entries disclose that this popularizer of science, a member of the Geological Society of London who had obtained a level of celebrity for this discovery of dinosaur fossil remains, consistently drew substantial crowds for his lectures on coral reefs.[17] The popular lecturer's diary documented not only the public enthusiasm for conversations on the geological aspects of this product of colonial tropic regions but also suggests the level of geology education acquired by Crystal Palace visitors prior to the opening of the exhibition.

In 1851, global coral came to London. For the generation of viewers educated with geological evaluations of this natural resource since the advent of the penny periodical articles, the exhibition narratives mapped the gallery spaces and encouraged personal encounters with colonial and foreign sources of the displayed unpolished coral branches. Exhibition guide books instructed visitors navigating through the galleries and evaluated the coral exhibits in terms of geographic regions of growth. In the layout proposed for the 1851 exhibition, organizers planned to juxtapose exhibit items for direct comparison by judges, manufacturers, and visitors, similar to display strategies employed

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[16] Mantell, *The Unpublished Journal of Gideon Mantell 1819-1852*, 153-154, 157.
[17] On Mantell's discovery of the Iguanodon, see Martin J. S. Rudwick, *Earth's Deep History: How It Was Discovered and Why It Matters* (Chicago: The University of Chicago Press, 2014), 163.

at the British Museum.[18] However, as historian James Buzard noted in his reading of the Royal Commission minutes, the installation did not proceed as first conceived. A compromise two months before the opening of the Great Exhibition resulted in an inversion of the layout, in which "nationality gets admitted on only a provisional basis, as an expedient in the process of unpacking" and customs inspections. As a result, Buzard argued, the Crystal Palace displayed items using a "cartographic" and not a "taxonomic" scheme.[19] Thus we read in exhibition guide texts the efforts of authors, prepared to narrate a museum-style comparison among serially-displayed specimens, now accommodating this impromptu shift in display strategy as they directed readers' attention to coral specimens distributed throughout the Crystal Palace.

Prior to the opening of the International Exhibition, geologist Robert Hunt, who also served as exhibition commissioner, wrote an extensive article describing the scientific attributes of global geological raw materials anticipated for display in the Exhibition galleries.[20] His narrative, published in the January 1851 edition of *Art-Journal*, explained aspects of coral quality – defined by the parameters of size and color – as a function of the environment. The geological argument for coral growth in response to changing environmental conditions was a prevalent topic in publications and lectures addressing upper- and middle-class Britons including Sarah Maria Smythe and members

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[18] Jeffrey A. Auerbach, *The Great Exhibition of 1851: A Nation on Display* (New Haven: Yale University Press, 1999), 93.

[19] *Minutes of the Proceedings*, March 5, 1851, 310 cited in James Buzard, "Conflicting Cartographies: Globalism, Nationalism, and the Crystal Palace Floor Plan," in *Victorian Prism: Refractions of the Crystal Palace*, eds. James Buzard, Joseph W. Childers, and Eileen Gillooly (Charlottesville, VA: University of Virginia Press, 2007), 45, 48-49. Cantor, "Guides to the Exhibition and Other Material Addressed to Visitors," 34.

[20] Hunt "was appointed one of the Metropolitan Commissioners for mineralogical exhibits" in June 1850. Geoffrey Cantor, "Guides to the Exhibition and Other Material Addressed to Visitors," in *The Great Exhibition: A Documentary History*, vol. 3, ed. Geoffrey Cantor (London: Pickering & Chatto, 2013), 33.

of her generation. As Mantell had observed in his popular *The Wonders of Geology* (1848), as an "important article of commerce" the resource coral "varies much in hue, according to its situation in the sea," messages conveyed to the demographic in attendance at the Mantell's Whittington Club, Salisbury Assembly Rooms, and Kensington lecture hall events.[21]

Hunt's *Art-Journal* article "The Science of the Exhibition" opened with his claim that contained within the "forms which attract attention as works of Art" are the geological "native resources" of Britain represented by specimens of extracted fossilized strata such as the Devonshire marbles and the coral limestones of Derbyshire.[22] It was clear, he continued, of the "advantage of geological science" offered to the nation in the extraction of these resources. Beyond the evaluation of domestic limestone, Hunt discussed coral sourced from the French colonial region of Algeria in the broader context of the resources extracted from various regions of Africa, noting

> In thus rapidly sketching off the characteristic productions of each country, it is hoped that it is understood that it is with reference to their value – scientifically – as pointing to new localities in which known substances are produced, and to their value as sources upon which the industry of the native population of each locality might with advantage be exerted.[23]

Hunt evaluated the management of imperial natural resources, including coral, within a dual framework. The first was the impact of British geologists on the identification of

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[21] Gideon Algernon Mantell, *The Wonders of Geology, or, A Familiar Exposition of Geological Phenomena* 6th ed., vol. 2 (London: Henry G. Bohn, 1848), 478, 618, 632. Mantell based *The Wonders of Geology* on his lecture notes. Mantell, *The Wonders of Geology*, vii.
[22] Robert Hunt, "The Science of the Exhibition, Part 1," *Art-Journal* (Jan 1851): i-xvi.
[23] Hunt, "The Science of the Exhibition," xiv.

new geographic regions in which to extract the raw materials. Additionally, the geologists' interpretation of the merits of resources for the nation served to unite indigenous labor with expanding imperial market demands.

In narratives published after the exhibition opened, Hunt mapped specific location of displayed coral. Hunt noted contributions contributed by administrators from the British colonial territories of "Bahamas, Barbadoes, [*sic*] and Bermuda," and specimens representing the Mediterranean island of Malta, in his portable *Synopsis of the Contents of the Great Exhibition of 1851*.[24] In the geologist's extensive *Hunt's Hand-Book to the Official Catalogues*, he urged readers to seek out the galleries "to the North of Turkey, West of that portion of France which is devoted to Musical Instruments," in order to observe the contributions of "that precious product" from the "great coral fisheries of La Calle" in North Africa.[25] In this context, both ephemeral and commemorative gallery guide publications addressed Victorian visitors of various classes and both genders with exhibit narratives that noted specific coral samples that illustrated the geological link between the quality of coral in response to local environment conditions. Contained in both Hunt's preliminary evaluation as commissioner and critical focus as guidebook author was the clear argument for the role of geologists in assessing the value of regionally extracted resources – scattered throughout the Crystal Palace colonial and foreign galleries – in the context of British interests in global economic markets.

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[24] Robert Hunt, *Synopsis of the Contents of the Great Exhibition of 1851: Companion to the Official Catalogue*, 2nd ed. (London: Spicer Brothers, and W. Clowes & Sons, [1851]), 70, 45.

[25] The entry ends with the following scientific classification: "It is the stem of an anthozooid zoophyte." Hunt, Robert, ed. *Hunt's Hand-Book to the Official Catalogues: An Explanatory Guide to the Natural Productions and Manufactures of the Great Exhibition of the Industry of All Nations, 1851*, vol. 2 (London: Spicer Brothers, and W. Clowes & Sons, 1851, reprint Cambridge Library Collection, 2011), 907-908. Identical text in *Official Descriptive and Illustrated Catalogue of the Great Exhibition of the Works of Industry of All Nations, 1851*, vol. 2 (London: Spicer Brothers, W. Clowes and Sons, 1851), 1261.

The amount of detail presented about individual exhibits published in periodicals shortly after the exhibition opening in May, 1851 suggests that editors relied on preliminary content such as found in Hunt's *Art-Journal* article.[26] From the first weeks of the Crystal Palace launch, newspapers, magazines, and printed guides mapped the location of colonial and foreign coral specimens in galleries in London's Great Exhibition of the Works of Industry of All Nations which reached, according to *The Illustrated Exhibitor*, "for the whole third of a mile, from east to west."[27] Guidebook authors were among the first visitors to the floor space, and urged readers to personally locate specific ranges of coral samples within the gallery spaces. In "A Hasty Run Through the Exhibition," released three days after the opening on May 1, the author directed the *Weekly Dispatch* readers' attention to the "south side of the nave," in which visitors viewed "chiefly raw produce," including "copper from the Burra Burra mines, seeds from Australia and Canada, flax, sponges, skins, furs, and corals, the natural productions of trophical [*sic*] and almost polar regions brought into close proximity."[28] Publications offering portable versions of the unwieldy official guides likewise indicated the precise location of coral specimens. For example, the Society for Promoting Christian Knowledge's *The Industry of Nations* printed an excerpt from the Official Descriptive and Illustrated Catalogue, describing the fossilized coral extracted from the British

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[26] Jeffrey Auerbach placed the number of exhibits at 100,000. Auerbach, *The Great Exhibition of 1851*, 95.
[27] "The Transept," *The Illustrated Exhibitor* 1 (Jun. 7, 1851): 12.
[28] "A Hasty Run Through the Exhibition," *Weekly Dispatch* (May 4, 1851): 3-4. For the author of an article in *Chambers's Edinburgh Journal*, the displays of raw materials offered an opportunity to visually witness the global extent of British influence. "And what 'latent possibilities of excellence!' We are sure every Englishman will feel proud of these manifestations; which indeed impart a new impression of our colonial strength." Samuel Johnson, *The Lives of the English Poets* (London: Jones & Company, 1825), 35 quoted in "A Glance at the Exhibition," *Chambers's Edinburgh Journal, New Series* 387 (May 31, 1851): 337.

colonial Maitland Mines, South Africa.[29] It is not surprising that jury reports published after the close of the Crystal Palace offered a scientific evaluation of the natural resource as they noted the national origin of the specimens. Jurors highlighted Mediterranean coral displayed in the galleries of the Italian region of Tuscany, and recognized the role of the French Minister of War and British colonial commissioners in the collection of coral specimens from Algeria and Bermuda.[30] What remains striking, however, was the manner in which publications for general audiences conveyed that the title of "coral" represented a range of exhibited products authors deemed worthy of inspection in the vast gallery spaces, encompassing Mediterranean branches and both fossilized and tropical specimens extracted globally and categorized as raw materials suitable for the "industry" of nations.

The following section examines the guidebook entries for unpolished coral specimens displayed in the International Exhibition's Centre Transept among British gems and precious stones, witness by visitors in the context of attractions including the Hope diamond and the recently acquired Koh-i-nor diamond, which, as Rudoe reminds us, were "unquestionably the stars of the show."[31] Here, too, Robert Hunt applied geological frameworks in his evaluations of coral presented in center court in narratives

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[29] *The Industry of Nations, as Exemplified in The Great Exhibition of 1851: The Materials of Industry* (London: Society for Promoting Christian Knowledge, 1852), 199. An Honorable Mention for exhibited coral was awarded to Maitland Mines, British South Africa. *Reports by the juries* (Presentation Copy, 1852), 164.

[30] Richard Owen, "Lecture III. On the Raw Materials from the Animal Kingdom, by Richard Owen, F.R.S.," in *Lectures on the Results of the Great Exhibition of 1851, Delivered before the Society of Arts, Manufactures, and Commerce, at the Suggestion of H.R.H. Prince Albert, President of the Society* (London: David Bogue, 1852), 127. *Reports by the juries on the subjects in the thirty classes into which the exhibition was divided. By authority of the Royal Commission*, Presentation Copy (London: W. Clowes and Sons, Printers, 1852), 164. I gratefully acknowledge the assistance of Stephen Van Dyk, Director, Cooper Hewitt, Smithsonian Design Museum Library and his suggestion to pursue jury reports as a line of inquiry. On colonial exhibits, see Paul Greenhalgh, *Ephemeral Vistas: The Expositions Universelles, Great Exhibitions, and World's Fairs, 1851-1939* (Manchester: Manchester University Press, 1988), 56.

[31] Rudoe, "Jewellery at the Great Exhibition," 67-69.

published from 1851 to 1862, incorporating Darwin's coral growth theory in continuing efforts to educate viewers in the geological reading of these displayed raw materials. Historian Katharine Anderson has situated her evaluation of mid-century British affinity towards red Mediterranean coral jewelry in the context of the concurrent Victorian immersion in natural history collections from seaside and aquarium, thorough which readers had been "taught the significance of their modest counterparts on British shores" in popularized accounts of marine zoology.[32] Hunt's narratives, however, document that exhibition coral narrataives were not only independent of the short-lived British fascination with coral jewelry, but also evidence of a broader engagement with Britain's geological past. In his capacity as Keeper of Mining Records and affiliation with the Museum of Practical Geology, Hunt considered the wider implications of global coral reserves for the British imperial economy, themes repeated in the final chapter of this project.

Part 2 – Center Court: Coral Branches in Circulation, 1851-1862

> The principal object is a superb, and for its size almost unique branch of rough coral in its natural state.
>
> *The Illustrated London News* (1851)[33]

[32] Anderson, "Coral Jewellery," 49.
[33] "Coral Ornaments by Paravagna and Casella," *Exhibition Supplement to The Illustrated London News* 19, no. 518 (Sept. 20, 1851): 357-358.

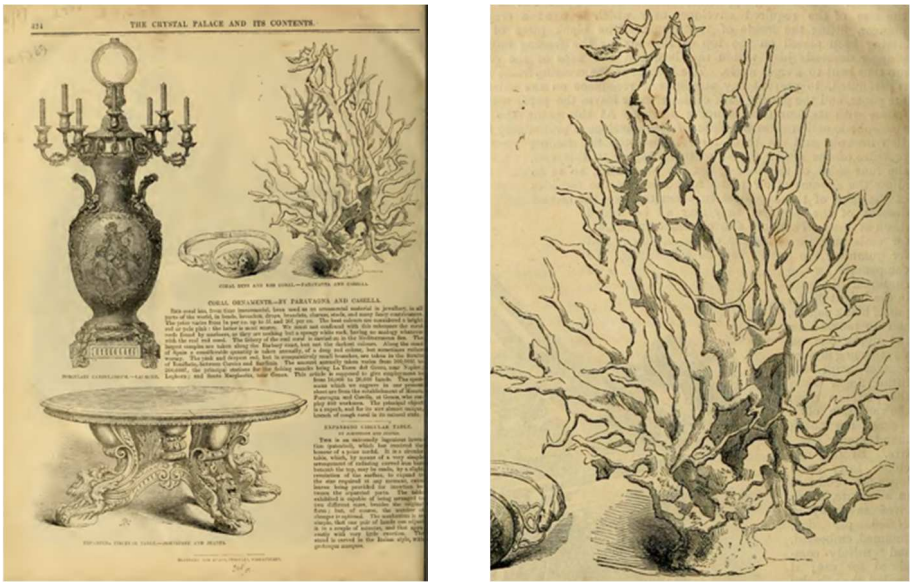

Figure 4.1. "Coral Ring and Red Coral by Paravagna and Casella." *Source*: *The Crystal Palace and its Contents* (1852), 424 and detail.

Official and unofficial exhibition guides informed mid-Victorian era gallery visitors about the attributes of coral raw materials best suited for the manufacture of jewelry that, prior to the late 1840s, the British had primarily regarded as what poet and author Thomas Campbell termed a "bit of ornament and a bauble" destined for eastern markets.[34] Since 1845, as Anderson has noted, British consumers valued red coral jewelry, and narratives in a variety of periodicals argued that where coral branches came from mattered.[35] Robert Hunt's *Hand-Book* noted the location of this raw material in the British gallery adjacent to the display of ornamental gems and minerals as an example of global coral which contributed to the expression of the nation's geological wealth.

[34] Thomas Campbell, "Letters from the South. Letter XVIII," *The New Monthly Magazine and Literary Journal* 46, no. 184 (Apr. 1836): 420. An earlier example of public awareness of this market and what Victorian authors identified as the "passion" for coral in India, see for example "On Coral and the Coral Fishery," *Penny Magazine* 9, no. 507 (Feb. 29, 1840): 79-80.
[35] Anderson, "Coral Jewellery," 47. See for example, "Newest London Fashions for February, 1845," *The World of Fashion: Monthly Magazine of the Courts of London and Paris Fashions, Literature, Music, Fine Arts, the Opera, and the Theatres* 251 (Feb. 1, 1845): 44.

In one account in *Exhibition Supplement*, *The Illustrated London News* insert designed as a visitor guide to be carried into the Crystal Palace, the author informed purchasers in global markets that geography determined coral quality.[36] "Coral Ornaments by Paravagna and Casella" described the growing conditions which contributed to the production of the "superb" red coral branch. As jewelry historian Charlotte Gere has briefly noted, the exhibitor displayed in 1851 "an enormous piece of branch coral, the size of a small tree."[37] "Samples of this bulk are considered great curiosities," the author explained, and such specimens "are of proportionately high value, being very scarce." Proceeding clockwise around the Mediterranean coastline, the article categorized the coral extracted from the southwestern region of French Algeria, for example, as "the largest samples," but "not the darkest colours." Advancing north to Spain's harvesting regions, coral fishermen brought to market "a considerable quantity" yearly, but the texture was "sometimes rather wormy." The Italian states of Corsica and Sardinia, meanwhile, harvested the "deepest red" hue.[38] It is likely that the exhibitor supplied both the text and illustrations for the ephemeral edition of *The Illustrated London News*, later reproduced in the commemorative *The Crystal Palace and its Contents*, which highlighted the quality of the contribution from the region of Naples.[39]

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[36] The two-page *The Illustrated London News* spread, printed in October in advance of the close of the Crystal Palace, situated the image of a bracelet vertically above the coral, its orientation suggesting the prominence of the crafted jewelry over the raw materials. Clark's entry altered the title and orientation of the woodcut components, impacting the permanent record of the exhibited materials. The jewelry originally labeled a bracelet in *The Illustrated London News* was identified as a ring in *Cyclopedia.* Changing the caption without changing the woodblock images effectively altered the scale of the pair of illustrations.
[37] Charlotte Gere, "Chapter 3: "The Exhibition Years," in *Victorian Jewellery Design*, (London: William Kimber, 1972), under "Visual Arts – Jewelry," *The Victorian Web* (Feb. 26, 2015), accessed July 15, 2015, http://www.victorianweb.org/art/design/jewelry/gere/3.html. Gere did not indicate the source of the coral narratives.
[38] "Coral Ornaments by Paravagna and Casella," in *The Crystal Palace and its Contents*, 424.
[39] *The Crystal Palace and its Contents; Being an Illustrated Cyclopaedia of the Great Exhibition of the Industry of All Nations* (London: W. M. Clark, March 27, 1852), 424. As Laurel Brake has documented, *The Illustrated London News* editors sold space in its supplement for exhibitor-supplied text and

Yet the *Official Descriptive and Illustrated Catalogue of the Great Exhibition of the Works of Industry of All Nations, 1851* (*ODIC*) entry situated the specimen in an alternate geographic setting. *ODIC* identified Paravagua and Casella as "importers and manufacturers" located on Philpot Lane, clearly situated in London.[40] Global contributions of coral raw materials to the London event, as previously noted, were identified by the region of extraction. Following the close of the Crystal Palace, exhibition jury members awarded an Honorable Mention to this firm's sample of "branch of natural rough coral," identified as "[o]ne of the finest examples" out of multiple foreign and colonial coral contributions.[41] Listed first in juror Richard Owen's awards for the category of raw materials derived from animal products, however, was an entry in the category Jewelry, class 23.

> One of the finest examples of the red coral (*Corallium rubrum*) is exhibited by Messrs. Paravagua and Casella, under No. 84, p. 683, Class XXIII, in connexion with cameo-work and carving in coral. The Jury desire to award to these

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illustrations. "To the Exhibitors in the Crystal Palace," *Illustrated London News* 19, no. 506 (Aug. 2, 1851), 142, cited in Laurel Brake, "Lost and Found: Serial Supplements in the Nineteenth Century," *Victorian Periodicals Review* 43, no. 2 (2010): 112, note 5. The newspaper also hired on-site by staff and contract artists. *Illustrated London News* 18, no. 490 (May 31, 1851): 503 quoted in Peter W. Sinnema, *Dynamics of the Pictured Page: Representing the Nation in the* Illustrated London News (Aldershot: Ashgate Publishing, 1998), 62.

[40] The exhibitor name was listed as Paravagna in the *ODIC* index, and as Paravagua in the text. "Alphabetical and Classified List of Articles Described in the Catalogue," *Official Descriptive and Illustrated Catalogue of the Great Exhibition of the Works of Industry of All Nations, 1851*, vol. 1 (London: Spicer Brothers, W. Clowes and Sons, 1851), xlix. *Official Descriptive and Illustrated Catalogue* vol. 2, 252. Exhibitors supplied a portion of the official narratives, according to Commission guidelines. "Introduction," *Official Descriptive and Illustrated Catalogue* vol. 1, 26. Exhibit text also published in *Official Catalogue of the Great Exhibition of the Works of Industry of All Nations, 1851*, 2nd corrected and improved edition. (London: Spicer Brothers, W. Clowes and Sons, 1851), 124.

[41] *Reports by the juries on the subjects in the thirty classes into which the exhibition was divided. By authority of the Royal Commission*, vol. 1 (London, Spicer Brothers, Wholesale Stationers; W. Clowes and Sons, Printers, 1852), 353.

> exhibitors Honorable Mention for the branch of natural rough coral above referred to.[42]

The exhibit crossed geographic and national boundaries established within the Crystal Palace. The physical location of the "superb" coral branch in the galleries reinforced the British identity of this Mediterranean branch. Visitors saw this singular red coral specimen in the nation's precious gems gallery, and not with the foreign contributions of the Italian states.[43] As previously noted, Rudoe documented from her reading of *The Illustrated London News* that the London-based firm of Paravagua and Casella displayed coral jewelry sourced "off the coast of Naples," since "there were no exhibitors from southern Italy."[44] The classification of the branched coral within the numerical listing of South Central Gallery exhibits containing British jewelry distanced the unpolished specimen from the category of "raw materials from animal products."[45]

The Crystal Palace exhibitor displayed the superb coral branch, moreover, in the privileged gallery adjacent to precious gems sourced from imperial regions, notably the

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[42] "Cameo-shells and Corals," *Reports by the juries on the subjects in the thirty classes into which the exhibition was divided. By authority of the Royal Commission*, Presentation Copy (London: W. Clowes and Sons, Printers, 1852), 164. Also *Reports by the juries*, vol. 1, 353. Cooper Hewitt, Smithsonian Design Museum Library.

[43] The 1851 exhibition was held prior to Italian unification, and commissioners located exhibits from these areas of the Mediterranean by geographic and political districts. On the political developments in this region of the Mediterranean, including Austria's influence and movements towards Italian unification during the early 1850s, see John A. Davis, "Italy 1796-1870: The Age of the Risorgimento," in *The Oxford History of Italy*, ed. George Holmes (Oxford: Oxford University Press, 1997), 194-200, Christopher Duggan, *A Concise History of Italy*, 2nd ed. (Cambridge: Cambridge University Press, 2014), xxii, 118-122.

[44] Rudoe, "Jewellery at the Great Exhibition," 70, 74. Rudoe cited *The Illustrated London News*, Sept 20, 1851 as a source of "an illustration of coral jewellery from this firm" but did not discuss the periodical's depiction of raw coral. Northern Italian states did participate, as indicated on *ODIC* directory map of global contributions. "Geographical View of the Great Exhibition," *Official Descriptive and Illustrated Catalogue*, vol. 1, following title page. The northern Italian States of Tuscany displayed raw coral. *Reports by the juries* (Presentation Copy, 1852), 164.

[45] *Official Descriptive and Illustrated Catalogue*, vol. 2, *Section III. Manufactures and Section IV. Fine Arts. Colonies*, 683, 124.

Koh-i-Noor and Henry Philip Hope diamonds.[46] Robert Hunt's exhibition guide inserted the singular red coral branch into the spectrum of British gems. Hunt was consistent in his narrative of this coral exhibit, and discussed the colonial and foreign samples in terms of mineralogy and geology, and his text ascribed British stewardship to this Mediterranean coral branch.[47] In contrast with the official narratives, Hunt structured *Hand-Book to the Official Catalogues* thematically, not numerically, and his entry situated the raw coral squarely in the category of Victorian-era precious stones.[48] Along with geological resources including "diamonds, sapphire, rubies, opals, topaz, [and] emeralds" extracted from imperial geographic locations, Hunt argued that Britain now played an essential role of the global circulation of this natural resource as a commodity.[49]

Hand-Book was not the only guide to frame this sample of Mediterranean coral with a British imperial narrative. *Tallis's History and Description of the Crystal Palace and the Exhibition of the World's Industry in 1851* provided readers with "lively and graphic description[s] that might be given in the course of social converse."[50] Tallis's sequence for the entries in this category paralleled Hunt's *Hand-book* while also

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[46] On the Koh-i-Noor diamond, see Danielle C. Kinsey, "Koh-i-Noor: Empire, Diamonds, and the Performance of British Material Culture," *Journal of British Studies*, 48, no. 2, (Apr. 2009): 391-419.
[47] Not every account of class 23 mentioned Paravagna and Casella's raw coral branch. For example, *The Illustrated London News* newspaper published a descriptive listing of jewelry and precious gems in August 1851. While the author's list mirrored Hunt's inventory of items, Z. M. W. did not include coral. As the author acknowledged, "I have far exceeded the space I had prescribed for myself on this occasion." Z. M. W., "A Lady's Glance at the Great Exhibition," *Illustrated London News* (Aug. 23, 1851) reprinted in *The Great Exhibition: A Documentary History*, vol. 3, 168.
[48] Hunt, *Hunt's Hand-Book* (1851), 624-637.
[49] While Hunt's section on rare gems identified most of the exhibitors as well as the description of their jewelry, his entries for marine products displayed in the jewelry department, including pearls and coral, listed only the catalogue number and a brief scientific description. Hunt, ed. *Hunt's Hand-Book* (1851) vol. 2, 624-637. On Hunt's role as a mineralogist, see Cantor, "Guides to the Exhibition and Other Material Addressed to Visitors," 33.
[50] "Introduction," *Tallis's History and Description of the Crystal Palace and the Exhibition of the World's Industry in 1851*, vol. 1 (London and New York: John Tallis, n.d.), iv.

reprinting the description of the red coral branch from *The Illustrated London News*'s *Exhibition Supplement*. In Tallis's volume, the Mediterranean coral also represented an imperial commodity classed as a raw material derived from animal products. *Tallis's History and Description of the Crystal Palace* situated the exhibitor's text extolling the merits of coral in the popular red hue in the space occupied by preeminently social displays of jewelry in the British section of the Crystal Palace.[51] Rhetorically, the "almost unique" raw material acquired a distinct geological identity and value originating in specific editorial decisions to categorize the object based on its geographic location in the London exhibition space. In 1851, Mediterranean coral was under Britain's geological gaze in the center galleries.

During the following decade, Robert Hunt expanded on the theme of the geological appraisal of Mediterranean coral in his evaluation of London jeweler Robert Phillips's curated assemblage of unpolished branches. Hunt announced in his publication for the 1862 London Exhibition that while Phillips's collection exemplified the "finest examples of gem carving in coral," the merits of his amassed samples lay in its importance "as a subject of natural history," and should be evaluated "independent of the art value."[52] In publications ranging from *Every Boy's Magazine* to *Art-Journal* contemporaries celebrated Phillips's collection of unpolished, or raw, coral branches.[53]

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[51] "Chapter XIV. Precious Stones – Mr. Hope's Collection - The Diamond, Sapphire, Emerald, Garnet, Etc. - Queen of Spain's jewels - the jewelled hawk - Pearls," *Tallis's History and Description of the Crystal Palace*, vol. 1, 84-87.

[52] Robert Hunt, *Handbook to the Industrial Department of the International Exhibition, 1862*, vol. 1 (London: Edward Stanford, 1862), 123.

[53] "In 1870 Phillips received a decoration from the King of Naples in recognition of all he had done to develop the coral trade of Naples." Flower, *Victorian Jewellery*, 18-19. For contemporary accounts, see *Art-Journal* illustrated catalogue (1872): 46 cited in John Culme, *The Directory of Gold and Silversmith 1838-1914: From the London Assay Office Registers* (Woodbridge, Suffolk: Antique Collectors' Club, 1987), 364-365. Also Deidre O'Day, *Victorian Jewellery* (London: Charles Letts Books, Limited, 1974, reprint 1982), 11.

Both *The Popular Guide to the International Exhibition of 1862* and *Cassell's Illustrated Exhibitor* lauded Phillips's samples "carefully collected during several years for the present Exhibition."[54] However, Hunt had highlighted the geological characteristics of the jeweler's unique objects during the months preceding the event. Mr. Phillips's specimens were "well deserving the inspection of the curious," Hunt argued, as he promoted the application of British geology in the evaluation of the extracted raw materials crafted into fashionable ornamental coral.[55]

Writing in *Art-Journal* in 1860s, Hunt proposed that the Geological Society of London members' research connecting the activity of coral located in the imperial metropole and periphery was a finding of interest to the readers of the magazine.[56] Citing Darwin's *On Coral Reefs* [sic], and his theory accounting for the "extraordinary workings of the coral animals in the Pacific Ocean," Hunt reviewed contemporary geologists' claims regarding coral growth in a manner which connected England's geological landscape with global regions concurrently explored by members of the British public such as Sarah Maria Smythe. Regarding the rock formations in Britain, Hunt noted that "[i]n the oldest of rocks their wonderful works are found, and mountains of limestone, in our own islands, have been formed by the coral polype."[57] While he confessed to the

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[54] Edward McDermott, *The Popular Guide to the International Exhibition of 1862*. (London: W.H. Smith and Son, [1862]), 34. "Curiosities in the Great Exhibition," *Cassell's Illustrated Exhibitor* (London: Cassell, Petter, & Galpin, 1862), 42.
[55] Robert Hunt, "Coral," *Art-Journal* 62 (Feb. 1860): 55-56.
[56] On the *Art-Journal* readership, see Katherine Haskins, The Art-Journal *and Fine Art Publishing in Victorian England, 1850-1880* (Surrey and Burlington, VT: Ashgate Publishing, 2012), 65-66.
[57] Hunt, "Coral," 55-56. Charles Dickens reviewed Hunt's *The Poetry of Science*, and noted the impact of geologists' writings on the public imagination, as "before the safety lamp" of geologists, the "Gomes and Genii of those dark regions have disappeared." Charles Dickens, "The Poetry of Science," quoted in Adelene Buckland, "'The Poetry of Science': Charles Dickens, Geology, and Visual and Material Culture in Victorian London," *Victorian Literature and Culture* 35, no. 2 (2007): 681. Relevant to this current project, Dickens further argued that as a result of geological research, readers have access to the "great stone book" on which to "read aloud" the geological evidence contained in "whole coasts of coral reefs" and "our own chalk cliffs and limestone rocks."

bourgeois readership of publication identified by its focus on the arts, that "[h]ad the character of this publication permitted it, we should have delighted to dwell on the extraordinary workings of the coral animals in the Pacific Ocean, so beautifully described by Mr. Darwin," Hunt hastened to convey to readers that the coral viewed in local regions throughout Britain were constructed "by the same process by which they are now forming the 'lagoon islands' and the 'atolls' of the Pacific Seas."[58]

Hunt then explicitly extended the geologists' argument concerning coral activity to the commercial products of the Mediterranean, arguing

> Those creatures which helped to build our world, as it exists to us, are busy, too, in forming, for the hand of man to display his skill upon, those branched, calcareous shrub-like creations, which, from decorating the depths of the European sea, are advanced to decorate the daughters of our sea-girt land.[59]

Coral animals constructed English Devonshire marbles and limestone structures as they "build our world" in the past while continuing to "decorate" our British "daughters" in the present.[60] The year before the second International Exhibition in London, Robert Hunt's *Art-Journal* article "Coral" made the explicit claim that marine products extracted from the "European Sea," in other words coral sourced from foreign waters, were constructed in a manner analogous to the historical coral foundation of Britain as a "sea-girt land."[61]

Hunt wrote his commentary as the Geological museum expanded its efforts into public education. Geological Society member colleague James Tennant had urged

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[58] Hunt, "Coral," 55-56.
[59] Ibid.
[60] Ibid.
[61] Ibid.

exhibition planners to arrange the 1862 international displays with popular instruction in mind.[62] Robert Hunt's framing of Phillips's collection during this time period as geological, not artistic, coincided with his efforts to promote the Museum of Practical Geology and School of Mines for an evolving emphasis on public education in economic geology. As noted in *Journal of the Society for Arts*, Hunt urged the planners of the 1862 Exhibition to "consult" with "men of science," so that the "approaching Exhibition would not only be made popular, but also an educational and instructional one to the country."[63] While geologists' didactic focus continued to promote methodology for the efficient extraction of resources, an additional emphasis included what Hunt regarded as the expansion of the geographic extraction range of currently mined geological materials.

Applications of geological approaches advocated by Hunt were demonstrated in Geological Society of London member Tennant's "Lecture on Gems and Precious Stones" delivered during the intervening years between the two exhibitions. Tennant had urged geologists to promote a disciplinary emphasis on extending the range of potential sources of imperial resources, and to

> draw the attention of all persons likely to travel in foreign countries, especially to Australia, Cape of Good Hope, India, and Canada, to the great importance of a knowledge of minerals. There is no country in the world possessing a wider range of territory or greater mineral wealth than Great Britain.[64]

The reviewer of the lecture argued that a focus on the identification of singular resources such as gold should not distract émigrés from other sources collected more broadly for

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[62] [Anon], "Abstracts of Papers, Lectures, and Discussions. Mineralogy and its Application to Geology and the Arts. By Professor J. Tennant, F.G.S," *The Journal of the Society of Arts* 2, no. 92 (Aug. 25, 1854): 680.
[63] "Discussion," *Journal of the Society for Arts* 9, no. 434 (Mar. 15, 1861): 288.
[64] "Abstracts of Papers, Lectures, and Discussions," 680.

the benefit of the nation, patterned after the extraction of the "carboniferous formation of England, in which iron, coal, lead, limestone, and sandstone yielded more than twenty million sterling annually."[65] For Robert Hunt, jeweler Robert Phillips's skill in differentiating among coral specimens, each decision involving the discernment of value based on close inspection and the examination of serial samples exposed to varying environmental conditions, paralleled this institutional mission to engage the public in geology as a science of continuing benefit to the nation into the 1860s.

Discussion – Geology and the Victorian Reader

By the early 1860s, a salient example of readers' framing of the Robert Phillips's exhibited coral collection through a scientific lens was evident in the pages of *Punch*, a popular Victorian-era satirical publication.[66] Coral, as the editors of the periodical observed, was geological. According to the article "Scientific Register," a member of the Geological Society of London presented a paper "upon a large number of miocene [*sic*] corals," which the lecturer had spied while "passing down Cockspur Street, in London." Wielding a hammer at the establishment clearly identified as belonging to Robert Phillips, this speaker recalled that he "fractured" the "transparent medium resembling plate glass" and extracted samples "embedded in several strata of a soft substance, not unlike velvet." To ensure the safety of the samples, he surrendered his coral evidence to "some feminine members of his household to whom he had unguardedly entrusted them."

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[65] Ibid.

[66] On the relevance of themes selected for magazine *Punch* to broader conversations in the public sphere, see for example Patrick Leary, *The* Punch *Brotherhood: Table Talk and Print Culture in Mid-Victorian London* (London: The British Library, 2010), 1.

As the President in the Chair admonished, "if the corals could not otherwise be obtained" for presentation at the next meeting, "bring the ladies themselves."[67]

The *Punch* author's portrayal of Mr. Phillips's London shop as a site for geological field work was clearly incongruous. Yet the process through which this fictional Victorian-era lecturer shared his quest to identify and extract coral specimens from the velvet strata offered a glimpse into what the editors understood to be the public engagement with active coral research presented at private Society session proceedings, now displayed at mid-century geological museums, exhibition galleries, and sites of field club excursions. British audiences engaged with visible manifestations of coral in public spaces in the context the field research into coral "out-of-sight," under the ocean waters and contained within the ground on which they walked.

Scholars from a variety of disciplines have considered publically exhibited mid-Victorian era coral specimens in the context of possession and ownership. Situated within the intersection of public and domestic spaces, expressions of Victorian attitudes towards collected coral reside within what Barbara J. Black has regarded as the society's "fascination with the accumulation and display of material culture."[68] The popularity of coral jewelry among the middle classes beginning during the mid-1840s and lasting through 1860s signaled fashion and – upon examination of court documents and theft reports – indicated a measure of individual household financial security. [69] During the

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[67] "Punch's Scientific Register," *Punch* 3 (Dec. 1864): 232.
[68] Barbara J. Black, *On Exhibit: Victorians and Their Museums* (Charlottesville, VA: The University Press of Virginia, 2000), 50.
[69] See for example Jan. 1851, trial of George Hopwood, Edith Hopwood (t18510106-384); Feb. 1851, trial of Jane Parnell (t18510203-546); May 1880, trial of William Brown (37) (t18800524-504); Nov. 1889, trial of Michael Lydon (19) Frederick White (19) James Tickett (25) George Tickett (62) Elizabeth Tickett (45) Job Gill (t18891118-55). *Old Bailey Proceedings Online*, version 7.2, accessed November 23, 2015, http://www.oldbaileyonline.org. The following chapter addresses changes in British market tastes and preferences. Here, I focus on the function of color in the public value ascribed to coral branch collections.

same time period, unpolished coral specimens acquired an exchange value independent of the finished products. British purchased coral branches from "shell-dealers" and naturalists' shops, as well as through private sales, attentive to published stories of counterfeits and recipes for imitations published by household advice columnists.[70]

Robert Hunt evaluated the geological nature of center court displays of visually striking materials raw coral branches at both the 1851 and 1862 International Exhibitions in London.[71] There remained, however, important differences between his two discussions published in the London exhibition guides that can be framed through the geologists' efforts to inform the public about the aggregate value of extracted resources derived from domestic and colonial regions.

In 1851, Hunt and Tallis's narratives regarded the red coral branch in the manner of a singular object, geologically mined, in discussions not unlike the selection and acquisition of diamonds and precious gems. This initial description was the exhibitor-supplied text, and it is not surprising that the inherent value of the one superb red specimen was ascribed to the environmental region of extraction. The analyses, however, ascribed ownership to the exhibitor in Britain in a manner consistent with resource management in global regions under imperial control.

By 1862, Phillips's collections containing multiple hues attracted media attention. *Cassell's Illustrated Exhibitor* noted about Phillips's selection, "[t]he inherent beauty of the material, showing every gradation of colour – from pure white to pale pink, from

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[70] Peter Lund Simmonds, "Marine Contributions to Art," *Art-Journal* (Aug 1873): 229. "Advertisement," *The Athenaeum* (Mar 5, 1864): 319.

[71] Judith Rudoe explained that South Kensington Museum accession records indicated Phillips had also displayed branched coral specimens at the 1851 Great Exhibition with British jewelry, although this was not recorded in *ODIC*. Geer and Rudoe, *Jewellery in the Age of Queen Victoria*, 241.

deepest red to jet black," exemplified the branches' "finer qualities."[72] The author added, moreover, that the jeweler displayed specimens "having been carefully collected during several years for the present Exhibition" in a manner that ascribed value as much to process of collecting as to the collection itself.[73] As Edward McDermott recorded in his volume "*The Popular Guide to the International Exhibition of 1862*, "Mr. Philips [sic], of Cockspur Street" showed the "rarest cabinet specimens" of coral branches.[74] The term "cabinet" evoked specific Victorian-era assemblages of unique items termed a cabinet of curiosities. Reviewers used a strategy that elevated each of the amassed items to the status valued possession in a manner which James Clifford as recognized as representing a "microcosm" of collected natural resources.[75] Displayed collections of serial geological samples demonstrated not only the skill of the collector but also the inherent value of the raw material removed from economic circulation and retained as a cabinet element.

The Victorian interest in the circulation of ornamental coral did not end with the decline in the nation's interest in further purchases of the polished material. On the contrary, the British public continued to apply geology and geological theories in the context of late-nineteenth century economics and marketing following the close of the 1862 exhibition. Peter Lund Simmonds, writing for the *Journal of the Society of Arts* in 1870, had recognized jeweler Robert Phillips's display of the material at the society's Wednesday evening meeting discussing the valuation of global markets for products

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[72] "Curiosities in the Great Exhibition," 42.
[73] Ibid.
[74] McDermott*, The Popular Guide to the International Exhibition of 1862*, 34. Similar sentiments in *Cassell's Illustrated Exhibitor*. "Curiosities in the Great Exhibition," 42.
[75] James Clifford, "On Collecting Art and Culture," in *The Predicament of Culture: Twentieth-century Ethnography, Literature, and Art* (Cambridge, MA: Harvard University Press, 1988); 227.

including coral.[76] Reviewing Simmonds's presentation for its broader readership, *Chambers's Journal* repeated the research of "one of our most indefatigable collectors and collators of information relating to the products of the vegetable and animal kingdoms" into the "facts" regarding international sales of the natural resource.[77] The final chapter demonstrates how and why Simmonds advocated an increasing role for geologists in extending British oversight in the extraction of global coral, a claim of ownership first staked in mid-century exhibition texts.

[76] [Peter Lund Simmonds], "On the Pearl, Coral, and Amber Fisheries," *Journal of the Society of Arts* 18, no. 896 (Jan. 21, 1870): 181.
[77] "Gems of the Sea," *Chambers's Journal of Popular Literature, Science and Arts* (May 21, 1870): 327.

CHAPTER 5

Art-Journal: Peter Lund Simmonds Confronts Geologists, 1860s-1870s

"A demand will, however, always be met with a supply."

Art-Journal, January 1870.[1]

Statistician Peter Lund Simmonds encouraged geologists to assume a more extensive role in Mediterranean field research into the rate of coral growth, and extended British management of global imperial resources to the harvesting of regional coral destined for foreign and colonial markets. This chapter demonstrates how periodicals including *Art-Journal* and *Journal of the Society of Arts* continued to serve through the end of the Victorian era as a platform for discussions regarding scientific interpretations of coral growth designed to increase supply to meet growing market demands.

"Coral Fisheries Declining," the front-page headline of London's *The Financial Times* had announced during the summer of 1888. "A very depressing report from the British Consul at Naples upon the Neapolitan coral fisheries has been received." The government account, echoed in a French Consul report, summarized the financial impact to Britain in light the news of this impending depletion of Mediterranean resources.[2] "The reefs or banks are now very much exhausted, and the coral taken is of very inferior quality, which causes great waste in manufacture, thus leaving little or no profit."[3]

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[1] "The Graphic," *Art-Journal* 9, no. 97 (Jan., 1870): 30.
[2] "The Coral Industry," *Chambers's Journal of Popular Literature, Science and Arts* (May 10, 1890): 303-304.
[3] "Coral Fisheries Declining," *The Financial Times* (Aug. 17, 1888): 1.

Within months, periodicals aimed at broader audiences, including *Chambers's Journal of Popular Literature, Science and Arts*, printed similarly dire statistics.[4]

Yet for Peter Lund Simmonds (1814-1897), the depletion of the coral "supply" and its impact on profits was neither unexpected nor unanticipated. Simmonds, moreover, took geologists to task, arguing that because they were "busy dredging and exploring the great depths of the ocean," the scientists lacked the focus necessary to resolve pressing economic issues for the British economy, namely, the rate of coral growth.[5] During the previous two decades, the British journalist had published broadly on the economics of the coral industry. His writings consistently alerted readers to statistics demonstrating the dynamics of international markets for marine commodities. Using regularly updated quantitative evidence, he built his case during the 1860s and 1870s that the lack of regulation of coral fishing impacted potential yield.

Simmonds noted that he compiled "supplementary information" from multiple contemporary and historical sources in order to track current trends and anticipate future demands for items including coral and pearls. "My object," as the fellow of the Statistical Society elaborated, "has been to condense into a brief compass such desultory notes and descriptions as would lead to reflection and investigation."[6] Robert Chambers recognized the value of this style of journalism in the synthesis of data.[7] Others observed that the author's contributions extended beyond economics to the social critiques. As Simmonds

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[4] "The Coral Industry," 303-304.
[5] Simmonds referred to the exploration of the *HMS Challenger*. On late Victorian-era ocean research, see Michael S. Reidy and Helen M. Rozwadowski, "The Spaces In Between: Science, Ocean, Empire," *Isis* 105, no. 2 (Jun. 2014): 347-348.
[6] Peter Lund Simmonds, "Preface," *Waste Products and Undeveloped Substances, or, Hints for Enterprise in Neglected Fields* (London: Robert Hardwicke, 1862), vi. David Greysmith, "The Empire as Infinite Resource: The Work of P. L. Simmonds (1814-1897)," *Journal of Newspaper and Periodical History* 6, no. 1 (1990): 6, note 18.
[7] "Gems of the Sea," *Chambers's Journal of Popular Literature, Science and Arts* (May 21, 1870): 325.

identified "the vastness of the hoard accumulated during the so-termed reigns of fashion," *The Academy* argued, the journalist's statistics "form both text and commentary upon the wealth and luxury of the age we live in."[8] For contemporaries, coral market statistics betrayed changes in the British social fabric revealed in the excess harvesting of the resource, and Simmonds called on geologists to assist in the repair.

This chapter argues that during the decline in the fashion for coral jewelry in Britain in the late 1860s, resulting from changing tastes and preferences, Victorian-era periodicals and magazines continued to follow global trends in the international coral markets through the end of the nineteenth-century.[9] Peter Lund Simmonds assessed the Victorian British stake in this network of coral trade. Because Simmonds produced his literary works using the format of a digest, his writing and analysis demonstrate that mid- to late-Victorian conversations about coral economics circulated within the broader themes of technology, commerce, and the science of geology. The statistician called on geologists to address coral growth rate as a component of supply necessary to match global market demands. Collectively, Simmonds's articles document the emerging Victorian framework for interpreting the British response to these changes in global trade.

As the first close reading of the journalist's analyses of marine products, this case study contributes to scholarship regarding this British literary figure in the context of the public use of geology to frame the economics of trade in coral sourced from foreign regions, outside British colonial geography. Timothy Cooper has analyzed the

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[8] Thomas Tod Stoddart, "Science: *The Commercial Products of the Sea: or, Marine Contributions to Food, Industry, and Art*. By P. L. Simmonds. (Griffith & Farran)," *The Academy* 340 (Nov 9, 1878): 455.
[9] For Katharine Anderson, the "fashion collapsed, perhaps under its own weight." Katharine Anderson, "Coral Jewellery," *Victorian Review* 34, no. 1 (Spring 2008): 47.

journalist's writings on mid-century environmental issues and waste management, and Pierre Desroches credited Simmons's "innovations that had both economic and environmental benefits."[10] In *Environmental History* (2015), Edward D. Melillo recently evaluated Simmonds's studies on agriculture and commerce.[11] This chapter documents Simmonds's relevance to Victorian-era book history as it situates the author's use of the genre of the digest in public efforts to interpret the British role in the nineteenth-century Mediterranean coral industry through the lens of geology.

The chapter proceeds chronologically, and begins with an overview of early nineteenth-century reports in the British press regarding international coral markets. Simmonds first engaged with this aspect of raw material commerce in his own monthly periodical *The Technologist* during 1862 and 1863. He then delivered an extended address based on this research to fellow members of the Royal Society of Arts in 1870. Simmonds's salient point was to alert audiences in London that the market for coral within the British imperial system – her trading partners, colonies, and Britain itself – constituted independent entities with distinct tastes and preferences for the finished products. Simmonds remained confident, however, that the Mediterranean coral industry could continue to supply these diverse demands. The next section of the chapter

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[10] Timothy Cooper, "Peter Lund Simmonds and the Political Ecology of Waste Utilization in Victorian Britain," *Technology and Culture* 52, no. 1 (Jan. 2011): 22. Pierre Desroches, "Victorian Pioneers of Corporate Sustainability: Lyon Playfair, Peter Lund Simmonds and the Society of Arts' Waste Products Initiatives," *The Business History Review* 83, no. 4 (Winter, 2009): 711. Writing in 1990 in the *Journal of Newspaper and Periodical History*, however, biographer David Greysmith had summarized Simmonds's efforts as "hardworking but anonymous and easily forgotten," yet "worthy of notice." Greysmith, "The Empire as Infinite Resource," 13.

[11] Edward D. Melillo, "Making Sea Cucumbers Out of Whales' Teeth: Nantucket Castaways and Encounters of Value in Nineteenth-Century Fiji," *Environmental History* 20 (2015): 455. Peter Lund Simmonds, *The Curiosities of Food: Or the Dainties and Delicacies of Different Nations Obtained from the Animal Kingdom* (London: Richard Bentley, 1859); Peter Lund Simmonds, *The Animal Food Resources of Different Nations: With Mention of Some of the Special Dainties of Various People Derived from the Animal Kingdom* (London: E. & F. N. Spon, 1885).

compares his early efforts with the lecture published in the Society's *Journal of the Society of Arts*, in which Simmonds called for increased analysis and British intervention to ensure coral supplies, clearly less secure in market capacity. Finally, the journalist's article in the widely read periodical *Art-Journal* is contrasted with the relevant chapter of his book *The Commercial Products of the Sea or, Marine Contributions to Food, Industry and Art* (1879), in which Simmonds identified technology one a solution to what he perceived as a shortage of raw materials.[12] Contemporary reviews indicate his impact on British audiences, and the reception of Peter Lund Simmonds's arguments confirms his view that the application of geological theory remained effective in addressing the inadequate supplies of coral as a commercial product during the post-Exhibition decades of the 1860s and 1870s.

Part 1 – The Coral Conundrum: Supply and Demand, 1862-1870

During the years following the 1851 Great Exhibition, the sponsoring organization relocated a portion of the exhibited materials to the South Kensington Museum.[13] The Royal Society of Arts tasked Peter Lund Simmonds with constructing inventories and preparing catalogue entries for the collection. He evaluated the myriad of raw material samples used in manufacturing formerly displayed in the Crystal Palace galleries.[14] As he noted in the preface to *Animal Products, Their Preparation, Commercial Uses, and Value*, Simmonds worked under the direction of the Scientific

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[12] Peter Lund Simmonds, *The Commercial Products of the Sea or, Marine Contributions to Food, Industry and Art* (London: Griffith and Farran, 1879).
[13] Barbara J. Black, *On Exhibit: Victorians and Their Museums* (Charlottesville, VA: The University Press of Virginia, 2000), 4. Jeffrey A. Auerbach, *The Great Exhibition of 1851: A Nation on Display* (New Haven: Yale University Press, 1999), 199-200.
[14] Greysmith, "The Empire as Infinite Resource," 8. *Catalogue of the Collection of Animal Products, South Kensington Museum*, 2nd ed. (London: George E. Eyre and William Spottiswoode, 1860), viii.

Referee of the Department of Science and Art, and the opening sentence in his description of "marine animal products for manufactures" addressing Victorian readers he framed these resources in rhetoric that united both intellectual domains – science and art – in the evaluation of these "magnitude of trade" globally in these resources that "contribute so greatly to our national wealth."[15] Specifically, Simmonds noted displays at the South Kensington Museum documenting the "very large trade is carried on in the fishing for and importation of coral, sponges, and shells, the plundered habitations of tenants of the deep," including "Messrs. Philips, 23, Cockspur Street" contribution of samples of "rough and polished red, white, and pink coral branches."[16]

The Society of Arts deemed Simmonds highly qualified for the task of inventorying and appraising global commodities. In his youth, the journalist had served briefly as a bookkeeper at a Jamaican sugar plantation during what biographer Greysmith termed the "tumultuous" period in the island's history.[17] Returning to Britain, the author had access to global newspapers and foreign journals as manager of a reading room during the late 1830s, through which he followed developments in colonial markets.[18] By 1841, Simmonds had served as secretary and contributing reporter to a periodical focused on economics and agriculture.[19] That same decade, he edited and published his own magazine, titled *Simmonds's Colonial Magazine and Foreign Miscellany of Trade,*

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[15] Peter Lund Simmonds, *Animal Products, Their Preparation, Commercial Uses and Value* (London: Chapman and Hall, 1877), xiv-xvi.
[16] *Catalogue of the Collection of Animal Products, South Kensington Museum*, 2nd ed. (London: George E. Eyre and William Spottiswoode, 1860), 88, 93.
[17] Greysmith, "The Empire as Infinite Resource," 5-6.
[18] "West India Club House and British and Foreign Colonial Reading Rooms, South Street, Chichester, P. L. Simmonds, British and Colonial Newspaper and Advertising Agent," quoted in Greysmith, "The Empire as Infinite Resource," 5.
[19] Greysmith, "The Empire as Infinite Resource," 6.

Commerce and Banking, which offered a "monthly summary of Colonial Intelligence."[20] The Society of Arts noted the author's skills in the preface to the South Kensington catalogue, and subsequently appointed Simmonds Deputy-Superintendent for Colonial Contributions to the 1862 international exhibition.[21] Simmonds thus acquired and applied extensive knowledge about the circulation of raw materials in British imperial commerce.

Concurrent with his superintendent duties in 1862, Simmonds began an analysis of the markets for pearl, amber, coral, and tortoise shells in a series of publications on what he termed marine products of the sea, a subset of objects explored during his previous efforts as museum cataloguer for the British holdings. Simmonds published his earliest articles on coral at a time of public enthusiasm for specific styles and colors of the costly polished material. Charlotte Gere and Judy Rudoe noted in the context of their history of Victorian-era jewelry that "Simmonds wrote copiously on coral."[22] His writings – a digest of statistical reports and government documents – conveyed his optimism in the ability of the Mediterranean industry to supply mid-Victorian era demands.

A brief overview of printed discussions available to British readers during the preceding three decades places his statistical work in context. During the first decades of the nineteenth-century, magazines and periodicals had published narratives and anecdotal evidence about the economics of the global distribution of polished coral from Italian

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[20] See, for example, "Contents: Monthly Summary of Colonial Intelligence," *The Colonial Magazine and Foreign Miscellany* 16, no. 63 (Mar. 1849): 112. Greysmith, "The Empire as Infinite Resource," 7.
[21] Simmonds, *Waste Products*, title page. Greysmith, "The Empire as Infinite Resource," 10.
[22] Charlotte Gere and Judy Rudoe, *Jewellery in the Age of Queen Victoria: A Mirror to the World* (London: The British Museum Press, 2010), 240, note 65. Shirley Bury, *Jewellery, 1789-1910: The International Era* (Woodbridge, Suffolk, England: The Antique Collectors' Club, 1991), 238-244 cited in Gere and Rudoe, *Jewellery in the Age of Queen Victoria*, 240, note 65.

manufacturing centers.[23] These early qualitative discussions focused on demand, and three themes conveyed optimism for unhampered growth in this area. The first aspect of consumer preferences reflected what Thomas Campbell had identified in 1836 as a "constant demand for this article in the East."[24] Early Victorian authors noted the geographic location of supply routes conveying coral to Eastern and African expanding markets which served, as Susan Torntore has explained, as a "powerful currency for trade with West Africa in the period of European expansion and was used in the European-West African slave trade."[25] Writing for *The New Monthly Magazine and Literary Journal*, Campbell described vast quantities "transported from Europe to Alexandria and Aleppo, and from thence to Bagdad, through which place it reaches Persia and India."[26] In 1840, *Penny Magazine* documented the rapid turnover of these products once at Eastern markets, observing "a ready sale is found for them."[27] India, at the time under the control of the London-based East India Company, served as a nexus for further circulation. As publisher Charles Knight explained in the context of his 1851 Great Exhibition narratives, coral trade between Bengal and China originated in Calcutta and crossed the Himalaya Mountains into Nepal.[28] Within the pages of early- to mid-Victorian era print, authors informed British readers about the Western awareness of vast networks of coral exchanged across expanding imperial and commercial territories.

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[23] Manufacturing centers included "Naples, Genoa, Livorno and Marseilles." Gere and Rudoe, *Jewellery in the Age of Queen Victoria*, 240.
[24] Thomas Campbell, "Letters from the South. Letter XVII," *The New Monthly Magazine and Literary Journal* 46, no. 184 (Apr. 1836), 420.
[25] Alan F. C. Ryder, *Benin and the Europeans, 1485-1897* (New York: Humanities Press, 1969) cited in Susan J. Torntore, "Precious Red Coral Markets and Meanings," *Beads Journal of the Society of Bead Researches* 16 (2004): 12.
[26] Campbell, "Letters from the South. Letter XVII," 420.
[27] "On Coral and the Coral Fishery," *Penny Magazine* 9, no. 507 (Feb. 29, 1840): 80.
[28] *Knight's Cyclopaedia of the Industry of All Nations* (London: Charles Knight, Fleet Street, 1851), 350, 1248.

An additional facet in the global coral trade explained to British readers prior to the Victorian interests in coral jewelry were contained in qualitative narratives arguing that fluctuations in global market demands were transient. For example, as Campbell observed in *The New Monthly Magazine and Literary Journal* (1836),

> The cholera, it is true, by spreading poverty and thinning population in eastern countries, lately checked the coral trade in that quarter; but the demand is now reviving, and you have only to look at the arms, coffers, and trinkets that come from the East, to see what a favourite coral is among the Orientals – adorning at once the sword-belts of their warriors and the necks of their beauties.[29]

In Campbell's tourism narrative, Europeans encountered exotic coral handiwork, and these specimens of Eastern material culture were evidence of expanding purchases despite the impact of endemic diseases on market dynamics.

Finally, the press noted that geographically distinct markets demanded specific colors of polished coral. Writing in *The Ladies' Cabinet of Fashion, Music, and Romance*, one author addressed upper middle class female British readers in the spring of 1840, hinting that "Coral, which has not during several years, been in fashion, for trinkets, is now very much in vogue" in Parisian fashions.[30] This red coral gained widespread popularity in Britain by 1845 and, as Katharine Anderson has noted, media attention focused on gifts presented to the Duchesse d'Aumale contributed to the popularity of this hue in coral jewelry.[31] Globally, according to a contemporary

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[29] Campbell, "Letters from the South. Letter XVII," 420.
[30] "Paris Fashion for the Month," *The Ladies' Cabinet of Fashion, Music, and Romance* (Mar. 1, 1840): 202. On the audience for this pocket-sized periodical, see Jeffrey Auerbach, "What They Read: Mid-Nineteenth Century English Women's Magazines and the Emergence of Consumer Culture," *Victorian Periodicals Review* 20, no. 2 (Summer 1997): 123.
[31] Katharine Anderson, "Coral Jewellery," *Victorian Review* 34, no. 1 (Spring 2008): 47, 51.

chronicler of Algerian political economy, during the mid-nineteenth century the Mediterranean manufacturing centers strategically exported "pink of the finest quality" to China, and differing grades and sizes to Russia, Poland, Bohemia, and India.[32] Because coral fished throughout the Mediterranean circulated into Italian regional centers for sorting, polishing and redistribution, subsequent exports readily supplied these varying regional and cultural demands.

By the 1860s, however, British consumers' shift in preferences asserted an abrupt pressure on this equilibrium. Pink coral rose in prominence among mid-Victorian purchasers, due in part to the visibility and promotion of such jewelry at a series of international exhibitions. One observer noted the shift in preferences, observing "the medium tints are little regarded."[33] "Coral, to be rare and valuable," *Art-Journal* instructed upper and upper-middle class readers, "must be of a delicate pinkish, flesh-like hue, uniform and in large pieces."[34] London police records of coral jewelry thefts, shifting adjectives from red to pink, documented this change in perceived value.[35] Charles William King's *Natural History of Gems or Decorative Stones* (1867) revealed

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[32] John Reynell Morell, *Algeria: The Topography and History, Political, Social, and Natural, of French Africa* (London: Nathaniel Cooke, 1854), 469. Also Cristina Del Mare, "Coral Products in Genoa, Leghorn and Naples between the Seventeenth and Nineteenth Centuries," in *Mirabilia coralii: manifatture in corallo a Genova, Livorno, e Napoli tra il Seicento e l'Ottocento, Coral Products in Genoa, Leghorn and Naples between the Seventeenth and Nineteenth centuries*, ed. Cristina Del Mare (Napoli: Arte'm, 2011), 28. On nineteenth-century global coral trade generally, see Susan Joyce Torntone, "Italian Coral Beads: Characterizing their Value and Role in Global Trade and Cross-Cultural Exchange" (PhD diss., University of Minnesota, 2002), 93-201.

[33] George Augustus Sala, *Notes and Sketches of the Paris Exhibition* (London: Tinsley Brothers, 1868), 209.

[34] Peter Lund Simmonds, "Marine Contributions to Art: Coral and the Coral Fisheries," *Art-Journal* (Aug. 1873): 229.

[35] 1850s theft reports for red coral included Jan. 1851, trial of George Hopwood, Edith Hopwood (t18510106-384); Feb. 1851, trial of Jane Parnell (t18510203-546). By the 1870s and 1880s, reports listed pink coral. May 1880, trial of William Brown (37) (t18800524-504); Nov. 1889, trial of Michael Lydon (19) Frederick White (19) James Tickett (25) George Tickett (62) Elizabeth Tickett (45) Job Gill (t18891118-55). *Old Bailey Proceedings Online*, version 7.2, accessed November 23, 2015, http://www.oldbaileyonline.org.

the extent of public clamor for this specific product. King noted that the "precious" pale pink coloring frequently was the result of altering the "deep-crimson, hitherto the most esteemed," and offered a recipe for baking coral since applying heat lightened the tint.[36] Previously revered red coral was permanently altered to produce the desired shade.

Mediterranean fisheries strove to satisfy this demand for product, and searched for alternative sources.[37] British periodicals followed this progress, specifically noting the discovery of pink coral beds. In 1862, during the London Exhibition, *The Times* reprinted an article from the *Malta Times* that revealed the reaction to the re-discovery of an extensive source of "light pink coral so much esteemed now-a-days."[38] During the market demand for red coral, this bed remained undisturbed and unharvested. Yet in 1862, forty coral fishing boats descended on the newly re-opened region, *The Times* article reported, until the local Chamber of Commerce demanded intervention "until regulations be made to prevent the needless destruction of the coral by inexperienced persons, in order that the greatest possible profit may be made to accrue from it to the public."[39] *The Illustrated London News* noted that the British surveying ship HMS *Medina* assisted the Italian government with a survey of the region.[40] Optimistic reports in the Victorian press remarked that "coral rocks exist in several localities round the coast, and a closer survey will doubtless discover many others."[41] *The Times*, however,

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[36] Charles William King, *Natural History of Gems or Decorative Stones*, 2nd ed. (London: Bell and Daldy, York Street, Covent Garden. Cambridge: Deighton, Bell, & Co., 1867), 103, referenced in Warren Francis, "About Coral," *The Treasury of Literature and The Ladies' Treasury* (Apr. 1, 1874): 169-172.
[37] Torntone, "Italian coral beads," 76-78. Basilio Liverino, *Red Coral, Jewel of the Sea*, trans. Jane Helen Johnson (Bologna, Italy: Analisi-Trend, 1989), 194-195. Del Mare, "Coral Products," 44.
[38] "Discovery of a Coral Bed," *The Times* (Jul. 24, 1862): 13.
[39] Ibid.
[40] "Metropolitan News," *The Illustrated London News* (Aug. 16, 1862): 179. Also "The Mediterranean Fleet," *The Times* (Aug. 8, 1862): 9.
[41] "Metropolitan News," 179.

cautioned readers to await further news on efforts to "regulat[e] this new kind of industry, which has so unexpectedly and so opportunely presented itself."[42] In the assessment of the British press, damage to these newly identified beds by amateur fishermen appeared to be the only impediment to the potential profits to be obtained from this timely discovery.

It was in this context of these media portrayals of threats to future harvests, then, that Simmonds mined sources to offer his evaluation on the state of the Mediterranean coral supply. The journalist conveyed caution optimism in articles published in *The Technologist: A Monthly Record of Science Applied to Art, Manufacture and Culture*.[43] As biographer Greysmith has argued, as the magazine's "editor and proprietor" Simmonds's focus in the monthly periodical was "discovering the resources of the four corners of the world for use in Britain," and fostering "indigenous industries."[44] Collectively, his articles regarding coral fishing argued for a continued place for the product in global markets, and expansion beyond the historical markets. For Simmonds, distribution was premised on the underlying prevailing assumption of adequate, if not abundant, supply.

Simmonds printed the first article in 1862, concurrent his obligations in preparation for the London exhibition. Titled "The Coral of Commerce," the essay began,

> As coral ornaments are again coming into fashion among the ladies, and coral is more likely to be sought for, a few words on this product of the fisheries may be deemed acceptable.[45]

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[42] Ibid.
[43] Simmonds founded *The Technologist* in 1861. Greysmith, "The Empire as Infinite Resource," 8-9.
[44] Greysmith, "The Empire as Infinite Resource," 9.
[45] [Peter Lund Simmonds], "The Coral of Commerce. By the Editor," *The Technologist* 2 (1862): 20-21.

Simmonds had been curator of coral jewelry at the South Kensington during the late 1850s, and this observation prior to the opening of the current international show established the tone for his discussion of commerce.[46] Simmonds reproduced a travel essay from *The Athenaeum*, published just months after the advent of the London coral craze, arguing that coral fishing "may be regarded as one of the most important in the kingdom of the Two Sicilies, as well as for the wealth it annually brings in, as also for the school it offers for training hardy, well-disciplined mariners."[47] This qualitative assessment of the pecuniary and moral benefits of coral harvesting recalled the historically abundant supply of Mediterranean red coral in the decade following the initial Victorian popularity.

Yet this was the early 1860s, and British markets had changed. Quoting from a recent article in *Art-Journal*, Simmonds offered recent statistics that according to Robert Hunt the market priced the rare "delicate flesh-coloured variety" at five times the price of gold.[48] Meanwhile, referencing reports from the previous year, "more has come to England than usual," indeed, "more than four times the quantity imported the previous year, and hence the price fell considerably" in Britain alone.[49] Global markets had shifted as well. The author's subsequent article "The Coral Fishery of the Mediterranean" located the trajectory of exports from Italy to "Persia, India, and China" via "Alexandria, Constantinople, and Aleppo," concurrent with increasing British imports.[50] Simmonds

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[46] Gere and Rudoe, *Jewellery in the Age of Queen Victoria*, 226.
[47] "Foreign Correspondence: Torre del Greco," *The Athenaeum* no. 975 (Jul. 4, 1846): 685. [Simmonds], "The Coral of Commerce," 22, 24.
[48] [Simmonds], "The Coral of Commerce," 22. Hunt's role in the 1851 exhibition documentation and guide books, authoring the *Synopsis* and *Hand-book*, as well as the pre-exhibition article in *Art-Journal* detailing colonial contributions, is discussed in chapter 4 of this present work.
[49] [Peter Lund Simmonds], "The Coral Fishery of the Mediterranean, By the Editor," *The Technologist* 3 (1863): 372, 376.
[50] [Simmonds], "The Coral Fishery of the Mediterranean," 376.

updated his work on the South Kensington Museum catalogue entry for coral with reports of accelerating harvests in attempts to satisfy demand.[51]

The journalist mined official foreign documents that indicated political responses to market demands. Statistical data contained in the "official Exhibition catalogue" of the Italian "kingdom" documented a sufficient supply of coral following Italian unification.[52] Colonial French Algerian customs information documented increased harvests in that region. As Mediterranean fishers continued to explore greater depths, they uncovered the "handsomest" samples of the raw material from "small forests" at a depth of six hundred and fifty feet.[53] Simmonds argued that with continued extraction over an extended range, the industry could satisfy Victorian current styles, while maintaining market values for pink coral.

For Simmonds, one factor potentially limiting the resources available at market remained the rate of coral replenishment. As Simmonds considered the impact of coral growth on supply, he turned to a recently released French scientific study of the Algerian coastal waters. Simmonds printed a translated extract of an early edition of Henri Lacaze-Duthiers's commissioned study, in which the professor discussed his discovery of the mechanisms of coral propagation.[54] The journalist, however, remained unconvinced about the report's conclusions, noting "To this day we possess but vague and indistinct accounts of the processes of formation and reproduction of coral."[55] For Simmonds, the

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[51] "Coral," *Catalogue of the Collection of Animal Products,* 92.
[52] [Simmonds], "The Coral Fishery of the Mediterranean," 377.
[53] [Simmonds], "The Coral Fishery of the Mediterranean," 373.
[54] Lacaze-Duthiers translated in [Simmonds], "The Coral Fishery of the Mediterranean," 374. Note that this report to the Governor-General preceded Lacaze-Duthiers's publication on coral industry and commerce in Henri Lacaze-Duthiers, *Histoire naturelle du Corail: Organisation, Reproduction, Pèche en Algérie, Industrie et Commerce* (Paris, London, Madrid and New-York: J. B. Baillière et Fils, 1864).
[55] [Simmonds], "The Coral Fishery of the Mediterranean," 374.

assessment of the future capacity of the industry required more British scientific investigation.

Taken together, these articles clearly addressed upper- and upper-middle class British readers and potential purchasers of the coral polished products His historical selection from the periodical *The Athenaeum* and incorporation of contemporary text from the *Art-Journal*, published two years earlier, signaled efforts to reach this target audience.[56] Without specifically addressing the news of the tumultuous decline in supply reported concurrently in *The Times* and *The Illustrated London News*, Simmonds reasoned that both colonial and foreign supplies of coral, a "product of the fisheries," remained politically secure. He referenced foreign government statistical reports on current yield in a manner that built upon the credibility afforded by his role in London's 1862 exhibition. During the first years of the 1860s, Simmonds's work offered a narrative of successful match of industry efforts with British demand for pink coral.

Part 2 – Alerting the Royal Society of Arts

By the end of the decade following London's second International Exhibition, however, Simmonds's optimistic tone shifted. Addressing the Royal Society of Arts in January 1870, he argued that further scientific studies of supply were a vital component of efforts to regulate of coral fishing. An active committee member on issues relating to commercial ventures in colonial regions, Simmonds frequently addressed the Wednesday evening gatherings of the Society, delivering nearly twenty addresses following his

[56] Robert Hunt, "Coral," *Art-Journal* 62 (Feb. 1860): 56 quoted in [Simmonds], "The Coral of Commerce," 21.

membership in 1853.[57] As the concluding paragraphs of the *Journal of the Society of Arts* article reported, Simmonds curated his talk and displayed at the meeting samples of "coral in all its hues and stages" supplied by jeweler Robert Phillips.[58] A reviewer noted that Simmonds displayed his own collection as well.[59] This visual evidence offered tangible support to his argument that regulation would ensure the availability of quality products.

In this address to Society members, Simmonds first offered anecdotal evidence that coral grew extensively in regions surrounding ocean floor termed banks, suggesting that these areas were in particular need of protection from external threats. In contrast to his use of statistical forecasting, his qualitative evidence in support of the idea of rapid and pervasive coral growth drew from a range of antiquarian and eighteenth-century historical documents.[60] Regarding Mediterranean harvesting in these regions of what he argued contained exponential growth, Simmonds wrote, "We are still ignorant on many points of the highest importance relating to the production and search of this handsome substance."[61] Continuing, he argued,

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[57] Greysmith, "The Empire as Infinite Resource," 8.
[58] [Peter Lund Simmonds], "On the Pearl, Coral, and Amber Fisheries," *Journal of the Society of Arts* 18, no. 896 (Jan. 21, 1870): 177.
[59] "Abstracts of Lectures. Science and Commerce: Illustrated by the Raw Materials used in our Manufactures, and Imported for Food Purposes. By Mr. P. L. Simmonds, F.R.C.I., F.S.S.," *Journal of the London Institution* 1, no. 9 (Dec. 13, 1871): 129.
[60] [Filippo] Cavolini, *Memoire por [sic] servire alla storia de polipi marini* (Naples, 1785): 32 cited in [Simmonds], "On the Pearl, Coral, and Amber Fisheries," 177. Since the early 1830s navigator Frederick Beechey had questioned the idea of rampant coral growth in the first decades of the nineteenth-century. F. W. Beechey, *Narrative of a Voyage to the Pacific and Beering's Strait, to Cooperate with the Polar Expeditions: Performed in His Majesty's Ship* Blossom*, in the Years 1825, 26, 27, 28* vol. 1 and 2 (London: Henry Colburn and Richard Bentley, 1831), 189. The following year, Charles Lyell included Beechey's stance in his *Principles of Geology* (1832). Charles Lyell, *Principles of Geology, Being an Attempt to Explain the Former Changes of the Earth's Surface, by Reference to Causes Now in Operation*, vol. 2 (London: John Murray, 1832), 287.
[61] [Simmonds], "On the Pearl, Coral, and Amber Fisheries," 177.

> The little that we do know, however, leads to the belief that the growth of coral is rapid, that its development is simple, and accommodates itself to very varied circumstances; that detached fragments from the bunch or principal stem have a vitality, and will voluntarily attach themselves to certain fixed substances, for continuing their development and forming new trunks; in fact, objects thrown in to the sea in the vicinity of coral banks will infallibly be found covered with coral in a few months.[62]

Not only do "submerged objects, whatever their nature, sustain equally this animal seed," but fragments of coral branches, torn during the process of harvesting, continue to propagate.[63] These sentiments expressed Simmonds and others including the author of an essay in *The Treasury of Literature and The Ladies' Treasury* promoted the idea that not only would overharvested regions rebound in a "vigorous" manner, but the resulting harvest of propagated coral fragment "grows into a fine specimen."[64]

Simmonds challenged scientists, arguing that they did not contribute scientific field research necessary to direct the regulatory process, and further did not respond to questions posed by commercial interests.[65] "These are most important questions, on the solving of which rests the complete regeneration and increase of the coral fishery. These are, however, questions as yet unsolved by naturalists."[66] While not naming the French

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[62] Ibid. For an illustration of coral encrusted objects, see for example Hans Sloan, *Natural History of Jamaica*, in James Delbourgo, "Divers Things: Collecting the World Under Water," *History of Science* 49 (Jun. 2011): 150.
[63] [Simmonds], "On the Pearl, Coral, and Amber Fisheries," 177.
[64] Francis, "About Coral," 171.
[65] Simmonds corresponded with Charles Darwin during the late 1840s on the topic of feasibility of emigration to Patagonia. There is no evidence that he considered the geologist's theoretic research on the rate of coral growth in his own economics arguments. "Peter Lund Simmonds, 1814-97," Darwin Correspondence Project, Darwin Correspondence Database, last updated on Jan. 19, 2014, accessed October 6, 2015, http://www.darwinproject.ac.uk/namedef-4356.
[66] [Simmonds], "On the Pearl, Coral, and Amber Fisheries," 178.

naturalist directly, Simmonds again invoked Henri Lacaze-Duthiers's research cited in *The Technologist*, inverting the French naturalist's findings into questions for the audience at this Wednesday evening lecture.

> What is most valuable to be known for regulating the search for coral, and for rendering the return more productive and more certain, is to ascertain at what age coral attains its largest size; how long it takes for an exhausted coral bank to again become rich and flourishing; at what period the eggs are laid; how are the products disseminated, at what period does the budding take place, and how long does it last? [67]

It is important to note that in addressing fellow members of the Society, as well as the larger reading audience for *Journal of the Society of Arts*, Simmonds requested this scientific investigation in order to support his call for the regulation of both coral exploration and extraction. The oversight of newly explored coral beds, in other words, required the input of naturalists to guarantee maximal returns on investment.

Immediate coral bed regulation was critical, Simmonds believed, in order to match what he identified as additional pressures on supplies. The statistician extracted from Italian export figures the existence of new culturally defined markets beyond the Britain. In the United States following emancipation, for example, "the coloured population have a great fancy for coral," and these statistics on purchases made by formerly enslaved African Americans were augmented by his documentation that "coral is even becoming in demand in the Pacific Isles."[68] Simmonds likewise interpreted Eastern cultural activities as increasing demands on production. "[A]ccording to

[67] [Simmonds], "On the Pearl, Coral, and Amber Fisheries," 177.
[68] [Simmonds], "On the Pearl, Coral, and Amber Fisheries," 179.

religious customs," the author argued, "each year sees buried a quantity of coral, more or less considerable, which has to be replaced."[69] He asserted that while traditional markets in Europe were sustaining purchases, unanticipated markets pressures since his 1862-1863 analyses required regulatory intervention.

In May of 1870, *Chambers's Journal of Popular Literature, Science and Arts* reviewed Simmonds's address to the Royal Society. Rather than merely circulating the journalist's arguments to a broader audience, however, the reviewer inflated several key points. First, the article escalated Simmonds's portrayal of tensions between the interests of naturalists and commercial harvesters. "Naturalists frankly confess," the reviewer asserted, "that they do not yet know the age at which the coral attains its largest size, the time required for an exhausted store to replenish or invigorate." The article editorialized, "In short, naturalists know that coral grows, but are very much in the dark as to *how* it grows."[70] Next, coral growth was rapid since "there is a power of easy adaptation to varying circumstances," consistent with post-*Origin of Species* sentiments. Finally, as previously noted, the *Chambers's Journal* author referred to the map of distant Pacific coral reefs produced by "Mr. Darwin," observing that extensive and "grand growths of coral" are "doubtless as beautiful as that of the Mediterranean; but being more remote from inhabited countries, it has not so much chance of being worked."[71]

This point-by-point analysis of the journalist's address clearly extended Simmonds's reach beyond the specialized readership for his technology magazine.[72]

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[69] Ibid.
[70] "Gems of the Sea," *Chambers's Journal of Popular Literature, Science and Arts* (May 21, 1870): 325, emphasis original.
[71] "Gems of the Sea," *Chambers's Journal of Popular Literature, Science and Arts* (May 21, 1870): 327.
[72] The *Chambers's Journal* article was reprinted as "Gems of the Sea," *The Eclectic: Monthly Magazine of Useful Knowledge* (Cincinnati) (Sept. 1870): 172-175, further extending Simmonds's readership. A portion of the article was also excerpted in "Coral," *Public Opinion* 18, no. 458 (Jul. 2, 1870): 15.

Issues raised in the review of the statistician's address revealed that the publisher Chambers considered these debates, constructed and delivered to Royal Society of Arts members, to be of interest to general audiences as well. The *Chambers's Journal* article expressed Victorian perceptions of a lack of oversight over geographically distant coral production and, by extension, supply. Despite prevailing impressions of rapid and adaptive coral growth, publishers conveyed the impression that a scientific understanding of these submarine organisms remained elusive.

Part 3 – *Art-Journal* (1873) and *The Commercial Products of the Sea* (1879)

The Naples International Maritime Exhibition, with its "great profusion and magnificence" of displays of "various ocean treasures employed in Art," represented a pivotal event in Simmonds's analysis of British engagement with the coral fishing industry.[73] Writing in *Art-Journal*, he reported that extensive exhibits of coral and jewelry displayed by local Italian artists surpassed previous exhibitions in both quality and volume. He interpreted this display as indicative of the trajectory of the industry. In other words, there appeared to be an unlimited supply of the "finest specimens."[74]

The journalist identified Naples as "head-quarters of the coral dredging and working operations," and his discussions in *Art-Journal* updated his Wednesday lecture at the Royal Society to include new insights into trade concurrent with the modernization of the industry. The periodical had published "Coral and the Coral Fisheries" as one of a series of nearly monthly installments during 1873 in which Simmonds evaluated the

[73] Peter Lund Simmonds, "Marine Contributions to Art: Pearls and the Pearl Fisheries," *Art-Journal* (Apr. 1873): 110.
[74] Simmonds, "Marine Contributions to Art: Coral and the Coral Fisheries," 230.

commercial applications of raw materials derived from marine sources. The author observed that his discussion of coral fishing was particularly justified, noting that "with the exception of a short scientific paper by Mr. Robert Hunt, F. R. S., in the volume for 1860, page 55," the topic had not been sufficiently addressed for readers of *Art-Journal*.[75] Simmonds was not claiming to offer a scientific explanation that would supplement the research of the Geological Society of London member Hunt discussed in the previous chapter, rather, to alert the geologists that their contributions were necessary to add practical, not theoretical, knowledge in order to increase supplies required with the application of new technology.

Newly investigated topics revealed an evolution in his own comprehension of the complexities of the late-Victorian British involvement with coral networks in three arenas. First, because of the escalating coral prices and demand, the "old primitive method of the drag-net or rough dredge," previously viewed adequate to "tear up the coral," now required improved methods of extraction. Technological advances employed in the Mediterranean included the use of larger fishing crafts supplemented by experimental illuminated diving bells. The "industry annually increases in importance," Simmonds observed, and "fishing is prosecuted with great energy."[76] British access to these supplies appeared secure.

Next, enthusiasm for the harvest was tempered by the mechanics of international coral exchange. On the topic of fraud, Simmonds's language was unequivocal. There

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[75] Simmonds, "Marine Contributions to Art: Coral and the Coral Fisheries," 229. Simmonds referred to Robert Hunt, "Coral," *Art-Journal* 62 (Feb. 1860): 55-56. The *Art-Journal* published Simmonds's writings on the commercial applications of raw materials derived from marine sources as a nearly monthly series. In addition to coral, topics included Tortoiseshell (Jan. 1873), Mother-of-Pearl and Pearl-Inlaying (March 1873), Pearls and the Pearl Fisheries, (Apr. and May 1873), and Amber and the Amber Fisheries (Oct. 1873).

[76] Simmonds, "Marine Contributions to Art: Coral and the Coral Fisheries," 229.

were limitations to the value of official British statistics on coral imports, and therefore a lack of British intellectual control over foreign coral markets. "The official statements of the imports of coral into the kingdom," Simmonds asserted, "are no reliable criterion of the actual extent of the trade." Close interpretation of the "bulky returns constituting the Blue Books of the Board of Trade," the statistician noted, indicated that British coral imports by weight in reality reflected a "most objectionable procedure," involving the use of cotton and silk in "great masses" to group the beads. These bundles, thirty percent thread by weight, constituted "an absolute fraud on the buyer." Fraud was perpetrated on the docks as well by coral fishers who exhibited, in Simmonds's opinion, "shrewdness and overreaching which is very remarkable."

> If [the fishers] are successful in finding a fine branch of the coveted pale rose coral, they will not dispose of it alone, but make it the medium for getting rid of their whole stock [the] entire lot for some fixed sum. The purchase of coral by the dealer becomes, therefore, quite a lottery.[77]

As Shirley Bury has noted, Simmonds disclosed of the inaccuracy of British coral import statistics.[78] "[M]erchants, jewelers, and, indeed, private individuals," the journalist reported, transported coral in "personal baggage" for security reasons, thus significantly underreporting the imported figures. He estimated the true value of coral imports in the early 1870s as £100,000 a year, not the recently reported figures £18,000 or £20,000.[79] Simmonds's message to his *Art-Journal* bourgeois readership was clear.[80] Because the

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[77] Ibid.
[78] Bury, *Jewellery,* 240. Simmonds, *The Commercial Products of the Sea*, 446.
[79] Simmonds, "Marine Contributions to Art: Coral and the Coral Fisheries," 230.
[80] On the *Art-Journal* readership, see Katherine Haskins, The Art-Journal *and Fine Art Publishing in Victorian England, 1850-1880* (Surrey and Burlington, VT: Ashgate Publishing, 2012), 65-66.

Board of Trade "ceased to enumerate coral specifically" after 1870, the danger of underreporting in the official statistics lay not in the import figures themselves, but by extension the true volume of extracted coral and value of materials in circulation in Britain.[81]

Simmonds's final assessment of the role of Britian in these international networks was his disappointment with a lack of scientific engagement in the Mediterranean fishing industry. Here, his analysis remained mired in his historically-based generalizations about coral growth. The journalist opened with his recurring theme of regulation, his discussion amplified by current events. British media focused attention on recent launch of the HMS *Challenger* in December of the previous year.[82] For Simmonds, topics "of paramount importance" for the coral industry have been ignored as scientists focused their attention on marine "dredging and exploring."[83] He directed a harsh appraisal of the ineffective activities of scientists, "learned naturalists" who "have been debating many moot points" regarding marine research.[84]

Because the article "Coral and the Coral Fisheries" provided the foundation for discussions in his 1879 book *The Commercial Products of the Sea*, Simmonds's accusatory statement literally framed the image of a red coral branch in the opening pages of the chapter.

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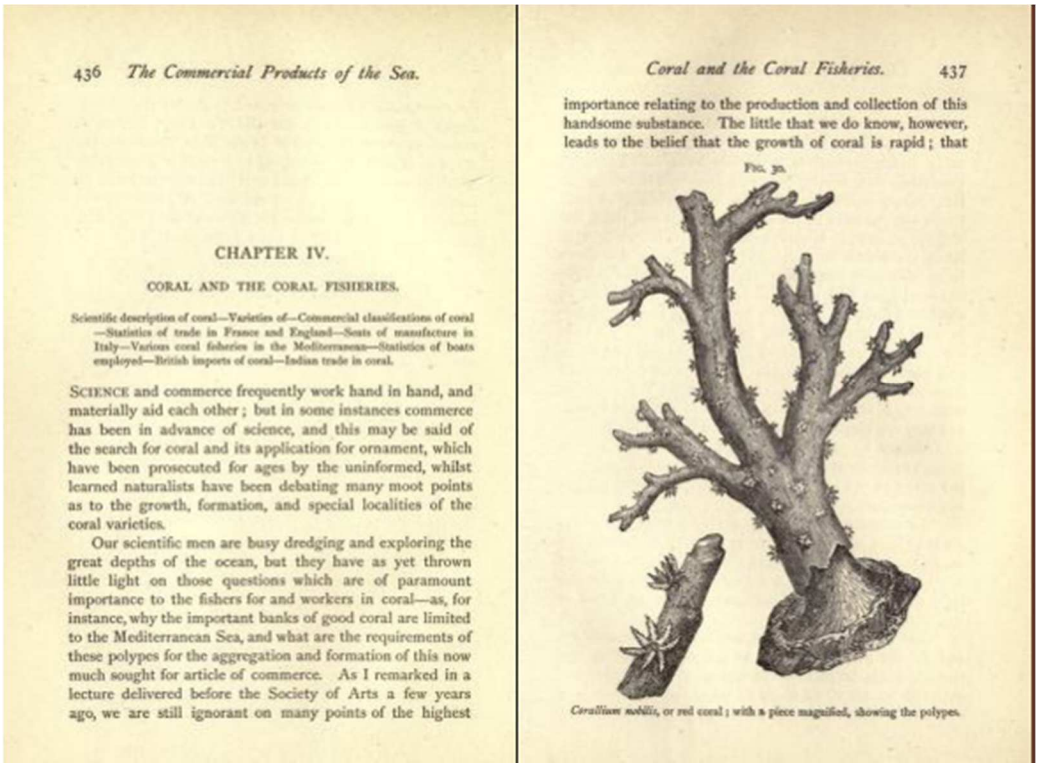
[81] Simmonds, *The Commercial Products of the Sea*, 460.
[82] Frank N. Egerton, "History of Ecological Sciences, Part 51: Formalizing Marine Ecology, 1870s to 1920s," *Bulletin of the Ecological Society of America* 95, no. 4 (Oct. 2014): 347.
[83] Simmonds, "Marine Contributions to Art: Coral and the Coral Fisheries," 229.
[84] Ibid.



436 *The Commercial Products of the Sea.*

CHAPTER IV.

CORAL AND THE CORAL FISHERIES.

Scientific description of coral—Varieties of—Commercial classifications of coral—Statistics of trade in France and England—Seats of manufacture in Italy—Various coral fisheries in the Mediterranean—Statistics of boats employed—British imports of coral—Indian trade in coral.

SCIENCE and commerce frequently work hand in hand, and materially aid each other; but in some instances commerce has been in advance of science, and this may be said of the search for coral and its application for ornament, which have been prosecuted for ages by the uninformed, whilst learned naturalists have been debating many moot points as to the growth, formation, and special localities of the coral varieties.

Our scientific men are busy dredging and exploring the great depths of the ocean, but they have as yet thrown little light on those questions which are of paramount importance to the fishers for and workers in coral—as, for instance, why the important banks of good coral are limited to the Mediterranean Sea, and what are the requirements of these polypes for the aggregation and formation of this now much sought for article of commerce. As I remarked in a lecture delivered before the Society of Arts a few years ago, we are still ignorant on many points of the highest

Coral and the Coral Fisheries. 437

importance relating to the production and collection of this handsome substance. The little that we do know, however, leads to the belief that the growth of coral is rapid; that

FIG. 30.

Corallium nobilis, or red coral; with a piece magnified, showing the polypes.

Figure 5.1. "*Corallium nobilis*, or red coral; with a piece magnified, showing the polypes." *Source*: *The Commercial Products of the Sea* (1879), 436-437.

It is important to note that in both the *Art-Journal* article and his book, the verbatim text of his previous lecture, "The little that we do know, however, leads to the belief that the growth of coral is rapid," followed this contemporary reference to British maritime explorations.[85] Simmonds repeated his points regarding the rapid growth of this commodity, retaining issues and "questions as yet unsolved by naturalists."[86] Moreover, these inaccuracies continued in a subsequent edition. The occasion of Simmonds's second printing, the publisher noted in 1883, was the International Fisheries Exhibition. In the preface, the publisher stated that this book, focusing as it does on "our marine harvests," "does for the library what the Exhibition [of 1883] does for the eyes, viz.

[85] "Chapter IV. Coral and the Coral Fisheries," Simmonds, *The Commercial Products of the Sea*, 436-437.
[86] [Simmonds], "On the Pearl, Coral, and Amber Fisheries," 178.

presents a complete survey of the commercial products of the sea."[87] Yet because this second volume was reprinted without changes, his outdated concepts of coral growth continued to circulate.

Discussion

"Coral is fished up as an article of commerce."[88] With these words, Peter Lund Simmonds succinctly summarized his evidence-based opinion that the Mediterranean coral industry served one primary function, namely, the harvesting and processing of the raw material to satisfy global demand. This case study documented the process of Peter Lund Simmonds's compilation and dissemination of statistical evidence of Mediterranean coral economics. While some deemed his digests not "strictly speaking original," others found his interpretations profound.[89] Simmonds had argued in "Coral and the Coral Fisheries" that while "Science and Commerce frequently work hand in hand, and materially aid each other," in the case of the "search for coral," a process operated successfully by the "uniformed," in his opinion "Commerce has been in advance of Science."[90] Naturalists acknowledged the validity of Simmonds's charge. In a review published in the journal *Nature*, Simmonds's book *The Commercial Products of the Sea* "shows how much has been done, and how much yet remains to be done by science, to make the most of the products with which the waters swarm."[91]

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[87] Peter Lund Simmonds, *The Commercial Products of the Sea: or, Marine Contributions to Food, Industry, and Art, New and Cheaper Edition* (London: Griffith and Farran, 1883), iv.
[88] [Peter Lund Simmonds], "The Coral of Commerce. By the Editor," *The Technologist* 2 (1862): 20-21.
[89] Stoddart, "Science: *The Commercial Products of the Sea*," 455.
[90] Simmonds, "Marine Contributions to Art: Coral and the Coral Fisheries," 229.
[91] "Book Review: *The Commercial Products of the Sea; or, Marine Contributions to Food, Industry, and Art*," *Nature* 19, no. 3 (Nov. 7, 1878): 3.

This chapter has demonstrated that British periodicals discussed international coral markets before, during, and after the nineteenth-century fashion for the polished material. Simmonds's contribution was his assessment of the Victorian stake in the supply side of this trade network, despite the lack of indigenous sources of the ornamental raw material. The journalist's articles and book offered a qualified and confident "compass," or digest, of information in three specific areas. First, the journalist provided French and Italian government statistics that offered confidence in the ability of the region to satisfy international coral markets. In particular, the author disseminated French naturalists' mid-century investigation of Algerian coral. While Simmonds repeatedly referenced Lacaze-Duthiers's research on coral anatomy, he also incorporated his subsequent statistics on Algerian "expenses and returns" in *The Commercial Products of the Sea or, Marine Contributions to Food, Industry and Art*.[92] Simmonds's experience in colonial Jamaica, together with his activities during the 1840s as editor and reporter writing on international trade, suggests that he valued obtaining documentation close to the source of the economic activity. Periodicals conveyed this intrinsic faith in the quantitative information provided to British readers.

Next, following the British jewelry fashion collapse, Victorian authors continued to frame market value in terms of the British tastes and preferences. In other words, color continued to be the marker of worth noted by journalists. An article published in *The Times* in 1888, for example, noted aggressive fishing for the commodity since "[i]n shallow water there is very little chance of finding the beautiful rose coral, which is said

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[92] Henri Lacaze-Duthiers, *Histoire naturelle du Corail: Organisation, Reproduction, Pèche en Algérie, Industrie et Commerce* (Paris, London, Madrid and New-York: J. B. Baillière et Fils, 1864) cited in Simmonds, *The Commercial Products of the Sea*, 454-455.

to be worth fifty times its weight in gold." Indeed, "the deeper it is the greater the probability of obtaining valuable coral."[93] Yet Simmonds, who noted that the British preference for the "flesh-like hue" was an "arbitrary standard of beauty," alerted Victorians to the concept that the coral industry viewed economic potential in a range of harvested coral products, not limited to jewelry. Exporters targeted broader global cultural markets as purchasers of specimens discounted by the British, noting

> Great quantities, when manufactured, are exported to India, and in Leghorn and Genoa several establishments work exclusively for that distant market, where blood-red coral, the colour which harmonizes with the dark complexions of the native ladies, is particularly in demand.[94]

Indeed, this market declined only when disease or reduced crop prices impacted disposable income and transactions with coral agents.[95] The author also suggested that developing markets in the Americas and colonial Pacific, while smaller in volume than the eastern regions, extended the range of varieties demanded.

Simmonds was an amateur naturalist, who not only catalogued the South Kensington collection but also maintained a personal collection of objects of natural history. Simmonds subsequently offered at auction his collected and labeled objects of natural history, obtained, as he noted in an advertisement in *The Athenaeum*, in conjunction with his role in the exhibition and "formed after many years' labour, under great official advantage."[96] While biographer Greysmith categorized the sale in the

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[93] "Coral," *The Times* (London, England) 32486 (Sep. 08, 1888): 9.
[94] Simmonds, *The Commercial Products of the Sea*, 459.
[95] Simmonds, *The Commercial Products of the Sea*, 461.
[96] "Advertisement," *The Athenaeum* (Mar 5, 1864): 319 referenced in Greysmith, "The Empire as Infinite Resource," 10-11.

context of the financial strain of publishing, the advertisement for catalogued specimens revealed Simmonds's pride in his both his collection and his privileged access to these items. [97] His practical experience with commercial raw materials thus influenced his considerations of the economic value of coral harvests to specimens purchased for "cabinets of economic products" as well as "objects of natural history and curiosity."[98] For Simmonds, the British press underestimated the impact of culture on the exchange value of coral in the international markets.

Finally, it was during his 1870 talk to the Royal Society of Arts, and the printed transcript in their *Journal of the Society of Arts*, that Simmonds first expressed what he viewed as an opportunity for the efforts of Victorian British geologists to directly impact the coral industry. In his opinion, scientific evidence of the rate and mechanics of coral growth would support regulatory attempts. As the London financial papers indicated, these efforts were directed initially towards the control of amateur harvesting that damaged the coral beds. Regarding the interaction between science and commerce more generally, as one reviewer noted, Simmonds had applauded the efforts of science and believed that chemistry, in particular, aided commercial efforts.[99] Yet in assessing the influence of British science on international supply, the lecturer argued that geologists had failed to recognize the urgent issues confronting the coral industry, to the detriment of global supply.

As Simmonds's addresses to his colleagues and mentors chiding the naturalists' inattention to these discussions disclosed, moreover, he escalated in tone with succeeding

[97] Greysmith, "The Empire as Infinite Resource," 10-11.
[98] [Simmonds], "The Coral of Commerce," 21.
[99] "Abstracts of Lectures. Science and Commerce," 127.

publication.[100] Simmonds consistently placed an "emphasis on innovative technology," Greysmith noted, from his earliest publications.[101] It is unclear in the report of this address to the Wednesday evening club if Simmonds directed his charge to specific naturalists. In attendance that evening was Edwin Lankester, Scientific Superintendent of the South Kensington Museum and meeting presider.[102] Likewise in attendance was Richard Owen, jury chair for raw materials drawn from animal products at the 1851 Great Exhibition and collection supervisor at the British Museum.[103] Yet for Simmonds, his nation's scientists engaged in "debating many moot points," while continental researchers applied technology to coral fishing.[104] Simmonds discussed experiments conducted by M. Foseli, off the coast of Naples as an example of Italian research leading to innovations including illuminated diving bells.[105]

Perhaps his role as publisher of *The Technologist* and subsequent monthly *The Journal of Applied Science and Record of Progress in the Industrial Arts* impeded the journalist's ability to recognize that these technologies adversely impacted coral supply. Simmonds viewed such advancements, employed off the coast of Algeria as well as in Italian waters, as progress.[106] Yet as noted in the beginning of this chapter, by end of the nineteenth-century British journalists and authors recognized that overharvesting,

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[100] [Simmonds], "On the Pearl, Coral, and Amber Fisheries," 178.
[101] Greysmith, "The Empire as Infinite Resource," 9.
[102] "Announcements by the Council: Ordinary Meetings, Wednesday evenings, at eight o'clock," *Journal of the Society of Arts* 18, no. 895 (Jan. 14, 1870): 151. On Lankester's role at the museum, see for example *Catalogue of the Collection of Animal Products, South Kensington Museum*, 2nd ed. (London: George E. Eyre and William Spottiswoode, 1860), n.p. Also Mary P. English, *Victorian Values: The Life and Times of Dr. Edwin Lankester M.D., F.R.S.* (Bristol: Biopress, 1990).
[103] "Announcements by the Council," 151. On Owen, see Nicolaas Rupke, *Richard Owen: Victorian Naturalist* (New Haven: Yale University Press, 1994).
[104] Simmonds, "Marine Contributions to Art: Coral and the Coral Fisheries," 229.
[105] Simmonds, *The Commercial Products of the Sea*, 453. On Foseli, see also "Untitled," *Grey River Argus* 12, no. 1218 (June 24, 1872): 2.
[106] Simmonds, *The Commercial Products of the Sea*, 455.

regardless of the source, contributed to the coral bed crisis. Aggressive coral harvesting used "the diving-bell and other machinery by aid of which the rocks can be more thoroughly cleared of coral," observed *Chambers's Journal* in 1890. "No doubt the use of the latter has done something to hasten the diminution of the supply."[107]

This chapter demonstrated that the British press revealed that the purchasers of coral anticipated the Mediterranean coral industry would have the capacity to meet increasingly capricious market demands. Coral existed simultaneously as a geological structure similar to precious gems that was mined and polished, as well as a living entity, capable of self-propagation and replenishment despite aggressive over-harvesting. Simmonds's call for both technological and scientific interventions expressed the upper- and middle-class purchasers' expectations that a geological framework for assessing coral growth continued to equate with progress for Victorian-era Britain in foreign and domestic economic spheres.

[107] "The Coral Industry," *Chambers's Journal of Popular Literature, Science and Arts* (May 10, 1890): 303.

EPILOGUE

Punch and the Politics of Victorian Coral Geology

> A cruise of a coral plantation reveals the most fairy-like views it is possible to conceive, reminding one of a grand transformation in a pantomime, the haunt of the mermaids, or something that.
>
> J. W. Boddam-Whetham, *Pearls of the Pacific* (1876) [1]

This project concludes its reading of coral in the Victorian-era with a demonstration of the public use of a geological interpretation of coral growth in the context of British imperialism. The periodical *Punch* had addressed the Irish Home Rule Parliamentary discussions at multiple times during the debates, and an illustrated essay printed January, 1902 satirized comments made during the previous week's debates that invoked the image of coral activity.[2] As reported in Hansard, George Wyndham had defended the slow progress displayed by both political parties at recent sessions of the British House of Commons.[3] The Chief Secretary for Ireland highlighted Tory and Radical "humility" during deliberations on the Irish Land Question, noting that for these politicians,

> they have never assumed to themselves a power other than that exercised by the coral insect in the natural world, that is, to do their own small part hoping that

[1] J. W. Boddam-Whetham, *Pearls of the Pacific* (London: Hurst and Blackett, 1876), 172.
[2] [Henry W. Lucy], "Essence of Parliament. Extracted from the Diary of Toby, M. P.," *Punch* 3189 (Jan. 29, 1902): 85.
[3] On contemporary attitudes towards the prolonged negotiations, see for example Fergus Campbell, "Irish Popular Politics and the Making of the Wyndham Land Act, 1901-1903," *The Historical Journal* 45, no. 4 (2002): 755-773.

> some day the last of their line and genus will perish when the whole work is accomplished.[4]

Wyndham's colloquial comparison between the efforts of the House of Commons members and those of the "coral insect" characterized the absence of noticeable progress as the inevitable outcome for a project with a timeline analogous to that of the construction of a coral reef.

The following day, the representative from County Mayo retorted, "so far as I recollect from my knowledge of geology, it takes many millions of coral insects many millions of years to construct a very frail and scarcely inhabitable little island." Indeed, as John Dillon countered, "at the end of a million years the last Chief Secretary will perish leaving their descendants as badly off as those unhappy people themselves."[5] The speaker presented his argument that his image of coral, in the context of a geological timeframe, framed his frustration with minute and nearly immeasurable progress during the long deliberations.

The *Punch* coverage of the debate made no direct reference to coral in the article text. Yet the title of the accompanying illustration depicted various members of the British House of Commons as coral insects, and clearly signaled the artist's engagement with Dillon's reference to geology. The large "cut," or woodcut, revealed the specific perspective viewed from the surface of a shallow lagoon, as if in a "cruise" over what tourism guides including *Pearls of the Pacific* (1876) author regarded as a "coral

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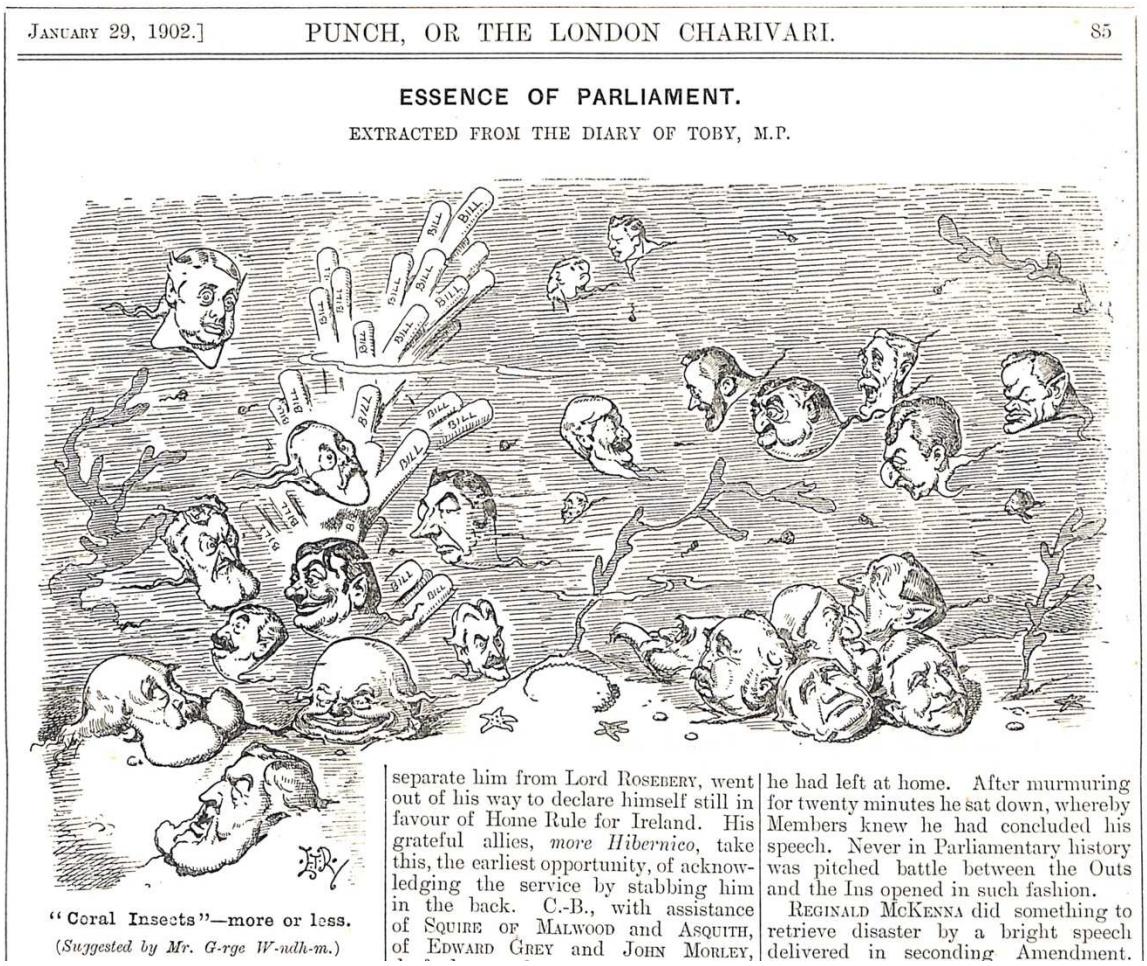
[4] "Irish Land Question. The Chief Secretary for Ireland, Mr. [George] Wyndham, Dover," vol. 101, Parl. Deb. (4th ser.) (23 Jan. 1902) c. 758, accessed July 10, 2014. http://hansard.millbanksystems.com/commons/1902/jan/23/irish-land-question#column_758.

[5] "Irish Land Question. Mr. [John] Dillon [Mayo East]," vol. 101, Parl. Deb. (4th ser.) (24 Jan. 1902) c. 845-846, accessed July 10, 2014. http://hansard.millbanksystems.com/commons/1902/jan/24/irish-land-question#S4V0101P0_19020124_HOC_164.

plantation."[6] Suspended over the Parliamentary waters, observing without being observed, *Punch* readers visualized the politicians as if specimens of the tropical variety brain coral clustered throughout the lagoon floor.



JANUARY 29, 1902.] PUNCH, OR THE LONDON CHARIVARI. 85

ESSENCE OF PARLIAMENT.

EXTRACTED FROM THE DIARY OF TOBY, M.P.

"Coral Insects"—more or less.
(*Suggested by Mr. G-rge W-ndh-m.*)

separate him from Lord ROSEBERY, went out of his way to declare himself still in favour of Home Rule for Ireland. His grateful allies, *more Hibernico*, take this, the earliest opportunity, of acknowledging the service by stabbing him in the back. C.-B., with assistance of SQUIRE OF MALWOOD and ASQUITH, of EDWARD GREY and JOHN MORLEY, he had left at home. After murmuring for twenty minutes he sat down, whereby Members knew he had concluded his speech. Never in Parliamentary history was pitched battle between the Outs and the Ins opened in such fashion.

REGINALD MCKENNA did something to retrieve disaster by a bright speech delivered in seconding Amendment.

Figure 6.1. "'Coral Insects' – more or less. (Suggested by Mr. G-rge W-ndh-m)." *Source*: *Punch* 3189 (Jan. 29, 1902): 85. Used with permission of Drew University Library, Madison, New Jersey.

[6] JBoddam-Whetham, *Pearls of the Pacific*, 172. "From San Francisco to Hawaii, and thence to Samoa and Fiji," *The Graphic* reported in 1876, Pacific islands are "becoming rapidly a regular tourist round," and Boddham-Whetham was one of the "dozen ready writers" who published on the topic since 1870. Review of J. W. Boddam-Whetham, *Pearls of the Pacific* (London: Hurst and Blackett, 1876) in "The Reader," *The Graphic* 13, no. 323 (Feb. 5, 1876): 138-139. For American geologist James Dwight Dana, the phrases "coral plantation and coral field are more appropriate appellations that coral garden [and] a convey a juster [*sic*] impression of the surface of a growing reef." Dana defined plantation as "a spot of wild land," unevenly populated with "only occasional tufts of vegetation." James Dwight Dana, *Geology* (New York: George P. Putnam and London: Putnam's American Agency, 1849), 104. James Dwight Dana, *Coral and Coral Islands*, 2nd. ed. (London: Sampson Low, Marston, Low and Searle, 1875), 189.

Artist E. T. Reed positioned a coral branch prominently in the drawing, its nascent lengthening limbs labeled "Bill" exhibiting just enough growth to break the plane of the water as it slowly developed in response to the shifting political environment.[7] For decades, the regularly featured "Essence of Parliament" had been a popular political platform for *Punch* magazine. The signature subtitle in each edition linked the illustration with the week's current events.[8] The caption, "'Coral Insects' – more or less. (Suggested by Mr. G-rge W-ndh-m)," incorporated both sides of the exchange among Parliament members recorded in Hansard. The subtitle "more or less" represented Dillon's counter to Wyndham's use of the imagery of "coral insects," rhetorically capturing inactivity over the argument for slow but sustained progress.

The publication of the *Punch* illustration demonstrated the magazine editors' confidence with late-Victorian readers' familiarity with geological interpretations of coral growth. The process of the selection of illustration topics at *Punch*, Patrick Leary has argued, was a deliberate editorial "search for common rhetoric" designed to link the staff and readers "in a public conversation."[9] For proposed satirical illustration themes to be accepted for consideration, the editorial staff debated internally whether subjects were "well enough known for a parody to be understood."[10] Frankie Morris noted that editor F. C. Burnand "had once remarked that if a cartoon's meaning was not 'written in the largest possible letters the British public would exclaim, 'What does it mean? We don't understand it.' Conciseness was a must."[11] Burnand's appointment of artist Reed to the

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[7] [Lucy], "Essence of Parliament," 85.
[8] Patrick Leary, *The* Punch *Brotherhood: Table Talk and Print Culture in Mid-Victorian London* (London: The British Library, 2010), 41-42, 111, 115. See also Frankie Morris, *Artist of Wonderland: The Life, Political Cartoons, and Illustrations of Tenniel* (Charlottesville: University of Virginia Press, 2005).
[9] Leary, *The* Punch *Brotherhood*, 41.
[10] Ibid.
[11] Morris, *Artist of Wonderland*, 226.

post of illustrator of House activities in "Essence of Parliament" following the retirement of Harry Furniss, and the editor's approval of the artist's distinctive interpretation of political figures, can be interpreted as confirmation of the younger artist's ability to recognize the Victorian zeitgeist.[12]

Yet what specific message was illustrator E. T. Reed communicating through this lagoon imagery regarding the measurable progress – or lack thereof – recently displayed among disheveled, untamed, and, for *Punch*, arguably dysfunctional members of Parliament? In other words, what did Reed anticipate that the general reader would understand in this interpretation of coral geology? In the context of this discussion of Irish Home Rule, Reed's use of a specific and recognizable tourist perspective in the coral lagoon woodcut was political, as it clearly invoked contemporary colonial imagery. Reed drew the *Punch* lagoon images as if viewed through late-Victorian water glasses, hand-held implements that offered clarity of sight by extending tourists' vision into the depths of the water. As one coral reef tourist narrated, travel parties used "wooden boxes about eight or ten inches square, open at the top, with window glass bottoms."[13] Handles up to three feet long allowed the operator to lower the device from the "side of the boat at anchor" below the surface of the water. The device enabled users in regions including the British colonial Bahamas to "see all the 'wonders of the deep' in the line of his vision

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[12] M. H. Spielmann, *The History of "Punch,"* (New York: The Cassell Publishing Co., 1895), 560-563. Morris, *Artist of Wonderland*, 563, 12. For the founding years of the periodical, see Richard Altick, *Punch: The Lively Youth of a British Institution* (Ohio State State University Press, Columbus, 1997). Joseph Finnan noted that E. T. Reed subsequently produced a "large proportion" of the nearly eighty woodcuts produced on "the Irish question" during a five-year period. Joseph P. Finnan, "Punch's Portrayal of Redmond, Carson and the Irish Question, 1910-18," *Irish Historical Studies*, 33, no. 132 (Nov. 2003): 425-426. Finnan cited Roy Douglas, Liam Harte and Jim O'Hara, *Drawing Conclusions: A Cartoon History of Anglo-Irish Relations, 1798-1998* (Belfast: Blackstaff Press, 1998).

[13] Charles Ives, *The Isles of Summer; or Nassau and the Bahamas* (New Haven, CT: Published by the Author, 1880), 217.

as plainly as he could if no water intervened."[14] The water glasses framed tourists' encounters with colonial tropic lagoon coral. The rendering in *Punch* situated the viewer within an imperial narrative.

It is important to note two ways in which Reed's use of this perspective, which editors argued resonated with Victorian viewers, conveyed a specific argument regarding the Irish Home Rule. First, late nineteenth-century tourist narratives reinforced conversations, including messages conveyed by statistician Peter Lund Simmonds during the previous decades, regarding coral regions as sites for British resource management. In addition, tourists exploring Pacific colonial islands including Fiji, annexed in 1874 following an overturn of Colonel William Smythe's ruling during the 1860s, framed coral geography as sources of imperial territorial expansion. Viewing "'Coral Insects' – more or less. (Suggested by Mr. G-rge W-ndh-m)" in this context reveals the public use of coral geology to interpret charged political climates.

British tourist John W. Boddam-Whetham, whose description of his cruise over the coral reef opened this present chapter, transitioned seamlessly in his narrative among the attributes of sugar, cotton, and coral plantations in colonial regions in the British territorial Pacific.[15] *Pearls of the Pacific* contained his economic analysis of the productions of the region, including the global food commodity *bêche de mer* harvested from the coral lagoons.[16] However, the author also viewed the coral environment an exploitable colonial source of what other tourist writers termed the "coveted" coral

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[14] Ives, *The Isles of Summer*, 217. On Ives, see "Charles Ives," *The Judicial and Civil History of Connecticut*, edited by Dwight Loomis and J. Gilbert Calhoun (Boston: The Boston History Company, 1895), 430-431.
[15] Boddam-Whetham, *Pearls of the Pacific*, 170, 175.
[16] Boddam-Whetham, *Pearls of the Pacific*, 170.

specimens such as those displayed at the British and South Kensington museums.[17] Boddam-Whetham explained to readers that the "vast lakes or lagoons which the reefs enclose are hot-beds for the most beautiful corals," and foresaw the potential for expanded colonial economic production in these regions.[18] Other late-Victorian conversations considered British colonial tropic lagoons as possible incubators, or nurseries, for the transplantation of "the more valuable red varieties" of Mediterranean coral for harvesting and marketing not to Victorian households, for the jewelry craze has subsided, but for what Simmonds regarded as foreign and British colonial markets including India.[19] In the context of the exchange between Wyndham and Dillon, Reed's geological analogy framed the management of Irish natural resources in the context of colonialism.

Popular tourist narratives used geology to anticipate that coral reef growth indicated potential increases in the geographic expansion of the British Empire, and here, too, Reed's illustration of the Irish Home Rule debates can be situated in this context. Published two years after the long-anticipated annexation of Fiji, *Pearls of the Pacific* conveyed Boddam-Wetham's assessment of the broader implications of the physical geography of the Pacific island region.[20] At the time of his writing, he noted, while approximately one third of the two hundred islands were inhabited, "in time, perhaps, a

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[17] C. F. Gordon Cumming, "First Impressions of Fiji," *Good Words* 22 (Dec. 1881): 607, Ives, *The Isles of Summer*, 222.
[18] Boddam-Whetham, *Pearls of the Pacific*, 281. As William Taylor has discussed, an early nineteenth-century artificial construction known as a "forcing-house," or hotbed, not only focused rays of light to increase plant production but "was also a reaction to an expanded sphere of natural resources to be exploited and human energies to be realized." William Taylor, *The Vital Landscape: Nature and the Built Environment in Nineteenth-Century Britain* (Aldershot: Ashgate, 2004), 51, 73.
[19] "XVI. The Coral Industry of British India," *Board of Trade Journal of Tariff and Trade Notices and Miscellaneous Commercial Information* 27, no. 161 (Dec. 1899): 694.
[20] Constance Frederica Gordon Cumming, *At Home in Fiji*, 2nd ed. (New York: A. C. Armstrong & Son, 1883), 1.

large portion of the ten thousand square miles which were lost by subsidence may be regained."[21] Coral reefs, he argued, the "numerous records of once lofty lands," represent regions for the future accumulation of "debris and the chance plantings of seeds by birds" and the resulting "increasing vegetation."[22] For the late-Victorian authors describing excursions to Pacific Islands including Fiji, regions "becoming rapidly a regular tourist round," offered evidence of Darwin's geological mechanism – and justification – for coral's role in the measurable expansion of the imperial "new world."[23] *Punch* editors, illustrators, and authors extracted themes, observed Leary, from "social situations of many kinds," and E. T. Reed's interpretation of the use of geology among British parliamentarians revealed the late-nineteenth century reading of coral in the age of Darwin, the public engagement with this scientific framework in the political arena.[24]

Imperial Coral

This project demonstrated the British public engagement with the nineteenth-century theory and practice of coral geology. As *Punch* observed in the second half of its satirical review of the reception of Beethoven's 9th symphony, if there was much written, there was "probably, therefore, so much read" about both the composer and coral by the 1880s.[25] Yet *how* did the Victorians read coral? As this project has demonstrated, the nineteenth-century British regard for coral differed significantly from twenty-first century perceptions of the natural resource. By widening the timeline beyond what scholars have

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[21] Boddam-Whetham, *Pearls of the Pacific*, 281.
[22] Boddam-Whetham, *Pearls of the Pacific*, 280-281.
[23] Review of J. W. Boddam-Whetham, *Pearls of the Pacific* (London: Hurst and Blackett , 1876) in "The Reader," *The Graphic* 13, no. 323 (Feb. 5, 1876): 138-139.
[24] Leary, *The* Punch *Brotherhood*, 41.
[25] [Henry Edwards], "Song and Supper," *Punch* (Feb. 18, 1882): 81.

recognized as the mid-century British embrace of coral jewelry and the aquarium, and extending the analytical lens from the post-Reform Act years through the end of the century, this project documented sustained engagement with coral geology throughout the long-Victorian era. Coral growth rhetoric in geological communications in print and illustrations directed towards – and written by – the general reader reveals a Victorian consideration of coral categorized more by Saul Steinbach's *A View of the World from New York* than by present day frameworks of intellectually isolated ecosystems.

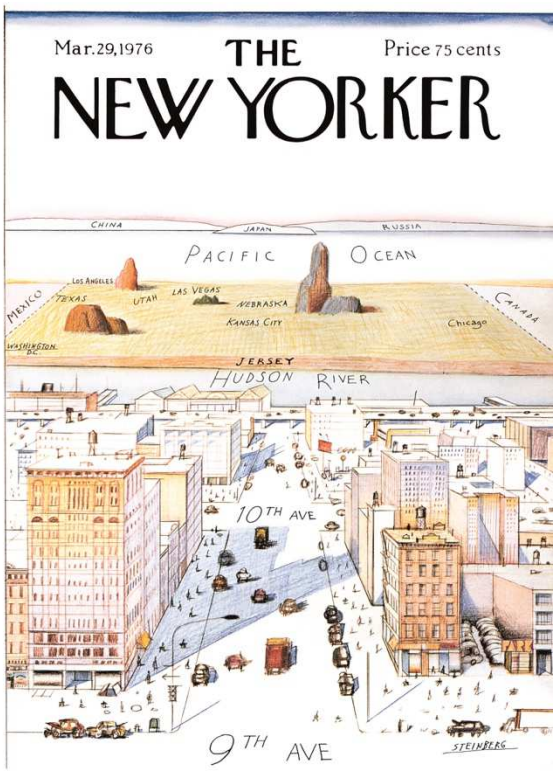

Figure 6.2. Saul Steinberg, "View of the World from 9th Avenue," 1976. *Source*: Saul Steinberg, View of the World from 9th Avenue. Cover of The New Yorker, March 29, 1976. © The Saul Steinberg Foundation /Artists Rights Society (ARS), New York. Cover reprinted with permission of The New Yorker magazine. All rights reserved. Used with permission, The Saul Steinberg Foundation /Artists Rights Society (ARS), New York.

The 19th century global map of the British coral estate was in imagination and in fact, like a "View of Coral from London."[26] The single term "coral" represented a resource available throughout the imperial network, subject to British oversight and management, and an object of British scientific geological study. Access to Geological Society of London members' research positioned Victorians as stakeholders in both local and global sources of coral throughout the long nineteenth century. Broadly viewed, the middle-class Victorians considered in this study regarded all coral, regardless of geographic location, as a single geological resource, and that resource was British.

The project first examined Geological Society of London members' outreach to British readers during the 1830s and 1840s using new print media including penny periodicals, the Colonial and Home Library series, and geological field guides. Society members brought closed-door discussions, negotiations, and debates regarding geological evidence directly to the general audiences. Geologists used modified woodcut illustrations and text to inform the public on how to interpret coral growth as predictable evidence of the nation's economic and social stability. Founding Society member Leonard Horner, active in dual social movements during the 1830s – the Geological Survey and the Society for the Diffusion of Useful Knowledge – mapped coral in *Penny Magazine* as evidence of domestic and international security. Horner's education of post-Reform Act readers on the geologists' role in identifying local sources of coral limestone, mortar, and fertilizer supported his "reading" of national interests.

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[26] Saul Steinberg, "View of the World from 9th Avenue," 1976. Saul Steinberg, View of the World from 9th Avenue. Cover of The New Yorker, March 29, 1976. © The Saul Steinberg Foundation /Artists Rights Society (ARS), New York. Cover reprinted with permission of The New Yorker magazine. All rights reserved. Used with permission, The Saul Steinberg Foundation /Artists Rights Society (ARS), New York.

During the following decades, Geological Society of London members continued to present ongoing coral research to the public in the form of British field guides. Authors modified Charles Darwin's visual argument for the process of coral growth in response to environmental change to instruct the public on interpreting geological findings in the British countryside. Contemporary coral growth in colonial regions explained historic limestone deposition. By the mid-Victorian era, as commentary in *Chambers's Edinburgh Journal* disclosed, Darwin's geological map of coral reflected the geographic reach of imperial Britain.

The second half of this project documented that readers not only recognized but also participated in an evolving worldview of coral, adapting British geologists' claims for a role in the nation's oversight of, and control over, the global natural resource. Chapter 3 explored the letters and drawings of a British colonial officer's wife stationed in the Pacific, and placed her communications with upper middle-class friends in Northern Ireland about coral reef crossings in the context of British geological theory. In the following chapter, Robert Hunt, member of the Geological Society, authored exhibition guide texts and article in which he argued for a geological interpretation of the publically displayed raw, or unpolished, coral branches at London's 1851 and 1862 international exhibitions. Peter Lund Simmonds was museum cataloguer for the coral objects displayed during these exhibitions, and published in quantitative assessments his appraisal of British economic interests in global coral harvesting. The fifth chapter argued that Simmonds called for geologists to intervene in coral growth debates with the application of practical field experience, not theoretical frameworks.

Three broad themes emerge from this project's analysis of the Victorian public engagement with geology in the study of global coral. First, early nineteenth-century geologists argued for a position as field researchers advancing the British domestic economy, through increasingly efficient mapping of fossil resources and the training of new practitioners. This study demonstrated that geologists delivered directly to the general reader the value – economic, but also political and social – in considering coral growth specific localized regions. As a result, geologists conveyed to readers that coral was simultaneously domestic and foreign, in the metropole and, in the words of Society member Robert Chambers, in the "antipodes" as well. Leonard Horner directed those for whom geology was "wholly new" the regional variation among limestone samples from Bath, Ketton and Portland. Oxford coral fossils resulted from organic remains deposited in readers' home regions. Charles Kingsley's narrative for residents of Chester outlined the volume of coral located from Bristol to Berwick. In this project, general readers, too, recognized the coral growth in specific regions in response to environmental change, in publications ranging from Sarah Maria Smythe's reading of Fijian coral passages in Bau, Levuka, and Lambeka to the cabinet of coral branches described in *Hunt's Hand-book* for London's exhibitions.

A second theme demonstrated in this project, and illustrated by E. T. Reed's satirical rendition of tropic coral lagoon landscapes evoking the geography of Ireland, is the idea that for the Victorian public, the map of British interests intersected with the geological map of coral at times of flux. This study opened with the founding of *Penny Magazine*, a time period that also corresponded with the post-Reform Act efforts at what Tony Bennett has regarded as the civilizing of the working and laboring classes. Leonard

Horner conveyed to precisely this anticipated readership that the local volumes of coral economic resources, a constituent component of both historic and contemporary geography mapped with mathematical precision by the new science, indicated British exceptionalism. Debates regarding changes in the practice of geology, a period of flux representing what William Whewell argued was a shift from the study of strata to the analysis of the forces in the earth's movement, were presented directly to the general reader during the 1840s and 1850s. Darwin's illustrations, published in both the Colonial and Home Library edition of *Journal of Researches* and his scientific monograph *Coral Reefs*, were visual arguments that field researchers immediately altered to support new trainees in locating economic resources in Britain. Sarah Maria Smythe's conversations on coral at the intersection of Belfast geological education and imperial expansion efforts offered an additional example of the public use of the science. Reading their arguments in tandem, Robert Hunt and Peter Lund Simmonds argued that during flux in the Victorian market demands for coral jewelry, practical and not theoretical geology best supported the British national interests in the oversight of the harvesting and supply of ornamental coral.

A final point documented in this project's research regarding the public understanding of the geological aspects of global coral is the Geological Society of London and Geological Survey members' aim to educate the public on how to visualize evidence of environmental change. For geologists, coral was both visible and unseen. *Penny Magazine* readers were urged to use "the power of every one who will look a little about him in the ordinary course of life," as the "substance itself must be seen."[27] The

[27] [Leonard Horner], "Mineral Kingdom. Section 2," Penny *Magazine* 2, no. 51 (Jan. 19, 1833): 19-21.

author of *Town Geology*, Charles Kingsley, instructed the working classes of Chester to look locally for evidence of Darwin's Pacific-region coral growth theory, noting readers "have but to look at the marbles commonly used about these islands."[28] Writing from Fiji, Smythe leveraged this Victorian mindset in her geological explanation for the location of gaps in specific coral reefs crossed during political negotiations. The publically displayed coral extracted from under the Mediterranean waters, first located in the Crystal Palace center courts and subsequently on-view at the South Kensington Museum, served as evidence of the inherent value contained in coral resources. Through rocks and reefs, subterranean and submarine, what Thomas Campbell had regarded in 1836 as Britain's coral estate came to represent global opportunities for economic extraction and political expansion.

"Reading Coral in the Age of Darwin" contributes to our understanding of the function of geology in the Victorian public mind as they articulated a world-view of Britain's economic, political, and social engagement with coral as a global resource. Coral formed the geological foundation of the island nation and its colonial expanse, simultaneously domestic and global. For Victorians, the map of imperial Britain was the map of coral.

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[28] Kingsley, *Town Geology*, 177. Reprinted in Charles Kingsley, "The Lime in the Mortar," *Good Words* (1873): 310.

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