

Darwin's Chalcopyrite: Engaging Museum Audiences with Global Extractive Stories

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Abstract

Challenging established narratives and acknowledging the colonial histories of natural history collections is an essential first step in addressing the structural racism that exists within European museums (Das and Lowe 2018). Mineral collections provide a direct link to the extraction and exploitation of natural resources, but mineral displays in museums rarely address the human, economic, and environmental conditions that brought these specimens to the museum, nor their framing within colonial power structures, focusing instead on inherent attractiveness and/or physical and chemical properties. As part of its strategic commitment to addressing this challenge, this paper outlines a case study in the Sedgwick Museum of Earth Sciences, Cambridge, where observations and collections made by Charles Darwin during his three-year voyage around the world on board HMS *Beagle* provide a window onto wider social and economic issues that continue to be relevant today. The presence of a strong, if one-sided documentary record coupled with a museum's commitment to sharing alternative narratives can challenge this 'museal silence' and enable the museum to address issues of social justice.

Keywords: mineralogy, museums, Charles Darwin, audience engagement

1. Introduction

Since 2019 the Sedgwick Museum (part of the University of Cambridge) has been transforming its approach to engaging audiences with its collections. As a university museum embedded within a world-leading Earth science research and teaching department, it plays a central role in encouraging and supporting the next generation of Earth scientists as well as in addressing the barriers and stereotypes that are preventing the field from being inclusive and globally representative. Earth scientists are and will be fundamental to our society's ability to address global challenges, including climate change, biodiversity loss and – of particular relevance here – sustainable resource extraction. By challenging existing narratives, preconceptions, and assumptions, the museum can actively contribute to making the field more inclusive and better able to contribute to an equitable global future.

Charles Darwin's prolific recording of his observations and reflections, developed during his three-year voyage around the world on board HMS *Beagle*, has previously enabled extensive and thorough analysis of his contributions to both geological and biological discourse (for example, Desmond and Moore 1991, Herbert 2005). This paper outlines how Darwin's observations relating to a set of rock and mineral specimens from Chile can also provide a window onto wider social-economic issues that continue to have relevance today. The specimens, now housed in the Sedgwick Museum of Earth Sciences in Cambridge, were gathered during visits to copper and gold mines in 1834 and 1835, including a horseback tour of the foothills of the Andes in August and September 1834. Darwin's narrative links the minerals he collected to the experiences of the Chilean people who contributed labour to their extraction and demonstrates how the specimens sit within a global trading network founded on labour exploitation. Thus, these specimens provide a means by which the Sedgwick Museum

can explore, discuss, and share these often challenging stories with their audiences through talks, tours, and gallery interpretation, and hence stimulate discussion around sustainable global extractive futures.

2. Context

2.1 Diversity and exclusion in museums and Earth sciences

The last twenty years have seen a wide recognition within the museums sector that an understanding of the legacies of empire is necessary to address systemic exclusion that many Black people and People of Colour have experienced in museums. In the case of the Sedgwick Museum, this exclusion is compounded by the woeful lack of diversity within the Earth science sector itself (e.g. Bernard and Cooperdock 2018) and further by some public perceptions of the University of Cambridge as being elitist. It has taken longer for the Earth science research sector to recognize the legacies of empire as a causal factor in the lack of diversity and as an inherent bias in research (e.g. Dowe et al. 2021; Raja and Dunne 2022), but some new initiatives in the last few years are driving progress in this area (see, for example, Rogers et al. 2022).

Earth science research has historically had a strong bias towards the search for, and extraction of, natural resources, in particular hydrocarbons. Coupled with a shift away from research funded by the extractive industries, research priorities are changing, with increased emphasis on, for example, understanding global climate systems, the interaction of climate and biodiversity and the search for sustainable ways to secure and extract critical minerals such as lithium.

This is the context and imperative to explore, understand and share alternative Earth science narratives in a careful and nuanced way and to ensure this work is prioritized in a climate of increasing expectations and decreasing budgets. The Sedgwick Museum has ambitious transformational plans, but it also recognizes that this work cannot wait for a major project. It is work that the whole team can contribute to, work that needs to take place in consultation and discussion with visitors, researchers, and stakeholders.

One area that the museum is keen to develop is around the specimens and stories that relate to the extraction of natural resources, with a view to stimulating discussion and debate around sustainable and equitable approaches to resource extraction in our global future. In this paper, I take a practice-based approach in outlining how looking again at a well-studied and high-profile historical collection has yielded additional and alternative perspectives. It has stimulated new discussions around resource extraction within the museum and contributed to building organizational confidence and skills to challenge other existing narratives.

2.2 The Sedgwick Museum

The Sedgwick Museum of Geology in Cambridge opened in 1904 as a memorial to Adam Sedgwick (1785-1873), with the primary intention of displaying the considerable and comprehensive fossil collections that he had collected during the 55 years he was Woodwardian Professor of Geology at the University of Cambridge. The museum itself, however, has a much longer history. Naturalist John Woodward (1665-1728) bequeathed his private collection of around 10,000 rocks, fossils, minerals, and antiquities to the University of Cambridge, along with funds to support a professorial chair in his name (Price 1989). Sedgwick was the seventh holder of this role.

Among the responsibilities of the Woodwardian Professor, as outlined in Woodward's will, was to show the museum's collections during prescribed hours to 'all curious and intelligent persons as shall desire a view of them for their information and instruction' (quoted in Price 1989: 84). Thus the Museum's current and future engagement with public audiences builds on a commitment to collections access for all that dates back nearly 300 years. Today, the Museum annually welcomes around 90,000 public visitors, enables more than 50 researchers to access the collections, and supports student learning and skills development.

The museum's collections have grown substantially since the original bequest and

now comprise more than a million fossils, half a million rocks, 55,000 minerals and 400 meteorites. The collections include more than 12,000 fossil type specimens, rock specimens from significant defining localities and strata, and at least 33 mineral type specimens. The collections include material gathered in the field by figures who are central to the development of science, including Charles Darwin, Mary Anning, Adam Sedgwick, John Stevens Henslow, and Alfred Harker. These collections are complemented by an extensive archive of field notebooks, documents, correspondence, catalogues, and photographs. Within the main collection, two sub-collections have particular relevance to narratives around resource extraction: the mineral collection, which has its origins in the collections of Sir Abraham Hume (1749-1838) and Joseph Carne (1782-1858), and the John Watson Building Stone collection, which comprises around 2000 matched specimens of building stones, roofing slates, roadstones, flagstones, decorative marbles, cements, and artificial stones, originating from both British and 'Foreign and Colonial' localities and gathered during the early part of the twentieth century by John Watson (1842-1918) (Andrew 1994).

2.3 Mineral displays and 'museal silence'

Like a scenic landscape or glossy magazine, [minerals] dazzle but remain impenetrable – all sheen and appearance

Artist Rona Lee in conversation with Liz Hide, 13 October 2022¹

Mineral specimens are central to museums' aspirations to build knowledge and understanding of the global economic role of natural resources. Yet museums rarely address this in their displays. Instead, displays habitually focus on the minerals' inherent attractiveness and their physical and chemical properties; they are presented as resources and tools of educational study. Hearth and Robbins (2022) provide a helpful framework to aid our understanding of the nature and intentions of mineral displays. They emphasize how, from the sixteenth century onwards, mineral collectors – whether private individuals or organizations – have displayed their holdings in order to demonstrate their power, taste, or education. Throughout the eighteenth and nineteenth centuries, the desire to demonstrate education and study led to an increased emphasis on classification systems, with mineral displays emphasizing categorization and taxonomy. In the Sedgwick, as a university museum, the desire to create a display that can support teaching has influenced how the public engages with minerals in these spaces.

Mineral classification continues to be a strong theme in many displays, not just in university museums 'despite the fact that mineral taxonomy has not been an interesting scientific question for almost 200 years' (Hearth and Robbins 2022: 13). Even before the recent increased interest in, and activity around, decolonizing approaches to museum collections, mineral displays have rarely focussed on the origins of their specimens, instead choosing to highlight mineral properties and uses. Gelsthorpe (2021), writing about one of the earlier published investigations into the colonial legacies of museum mineral holdings, highlights the absence of people: 'There has been a disconnect between scientific natural history specimens and most of the people involved in collecting them' (Gelsthorpe 2021: 21).

Of all types of geological specimens, minerals are the ones which are most embedded in economic practice: they are much harder to disentangle from economic and human history, and they hold powerful stories of exploitation; hence the urgent need to reconnect mineral displays with the people who extracted them.

This form of 'museal silence' originates, at least in part, from what Mason and Sayner (2019: 11) refer to as 'museums thinking they have nothing to say' about the origin of the specimens. Mineral specimens in museums, especially university museums, exist within a scientific structure of knowledge that has often obscured ('silenced') stories that do not focus on the science and that deem the role of people or economics to be irrelevant and unscientific. As a result, museum minerals are frequently displayed in ways that are entirely dissociated from the people that extracted them. Gelsthorpe's work at Manchester Museum is unusual in this respect: he has shown how the labour contributions of Black, Chinese, and Indigenous

people played a key role in the formation of what is now the Manchester Museum mineral collection. This work forms the basis of a new display, *Minerals: sustainability and hidden histories* in Manchester Museum and exemplifies Mason and Sayner's (2019) assertion that when encouraged to consider other ways of seeing their collections, museums can reveal previously hidden histories.

Even so, museums may actively or passively collude with a wider societal reluctance to consider that mineral extraction has involved the widespread and violent exploitation of Black, Indigenous, and People of Colour across continents and over hundreds of years, and continues to do so. Yusoff (2018, 2024) goes further to argue that the history of geology itself is closely intertwined with the development of race and racialization: 'Geology is a relation of power, and continues to constitute racialized relations of power... in its material manifestation in mining... and [its] toxic legacies'. She also notes that exposure to those toxic legacies is still cut 'along colour lines' (Yusoff 2018: 10). Hesitation to engage with such views provides a racialized form of museal silence around the mineral specimens.

When aiming to challenge these silences and to uncover and share stories relating to the origins of natural resources, the museum might turn naturally to the mineral and economic geology collections. But minerals were not intended to be part of the displays when the Sedgwick Memorial Museum opened in 1904: Adam Sedgwick's focus had been on enthusiastically and comprehensively expanding and developing the Department of Geology's fossil collections during his 55 years as Woodwardian Professor. It was not until the 1980s that the mineral collections belonging to the Department of Mineralogy and Petrology passed to the care of the museum, and the museum renamed itself the Sedgwick Museum of Earth Sciences. In 1997 the museum converted what had been the Woodwardian Professor's office into a small mineral gallery named for William Whewell (1794–1866; pronounced 'Hewl'), who held the position of Professor of Mineralogy from 1828 until 1832 and published *An Essay on Mineralogical Classification* in 1828. The displays in this gallery take a two-fold approach: wall displays provide a systematic review of mineral classification, while two central cases hold loosely structured displays of large attractive mineral specimens. The displays include technical language, diagrams, and ball-and-spoke models of crystal lattices. Most specimen labels just include the name and provenance of the specimen; in the case of a number of specimens, the locality is unknown. The only person pictured in the gallery is Whewell himself, with his portrait in pride of place over the historic fireplace, and the only people named in the labels are those who have had minerals named after them.² It is clear, therefore, that the concept of 'museal silence' is directly relevant to the current mineral displays at the Sedgwick Museum.

The scope of 'pure' mineralogy as a research discipline in Cambridge has much reduced in the period since the displays were installed. Such is the change in research focus over the last fifty years that there are few amongst the current academic faculty who have comprehensive practical mineral identification skills. Research has instead shifted in emphasis towards whole-earth systems, and those researchers who wish to study rock-forming minerals tend to use the museum's extensive Harker petrological collection, which is better documented and more suitable for their studies. Undergraduate teaching in Cambridge has changed, and there are plenty of alternative sources of information, with the result that these 1990s displays, despite their educational intentions, are rarely used by Earth science students, whether to promote formal learning as part of their course, to support revision, or to encourage additional learning.

Concomitant reductions in staff resourcing have meant that until recently it has been extremely difficult to explore alternative narratives in this collection, and the museum has prioritized investigating other parts of the collection, including those with a larger and better understood documentary history that might enable an exploration of stories of resource exploitation. For example, the John Watson Building stone collection has already been the subject of small research projects, including an AHRC-funded research internship (Hodgkinson 2022) and has considerable potential for further investigation. Therefore, we turn our attention to a historic part of the collection with a comprehensive documentary record which can enable us to bring a plurality of stories to the fore.

2.4 Challenging established narratives in the Sedgwick Museum

In 2019 the University of Cambridge launched a two-year academic investigation into the ways in which the university 'benefited from or challenged the Atlantic slave trade and other forms of coerced labour during the colonial era', and to make recommendations about how these legacies might be publicly acknowledged and their impact addressed. The initial report was published in 2022,³ and a full academic study is expected to be published in 2024. Alongside this work, the University of Cambridge Museums consortium (UCM: comprising the seven university museums, including the Sedgwick Museum, and the Botanic Garden) launched an ambitious programme which took a similar approach to our own collections and appointed a Legacies Research and Engagement Fellow, Danika Parikh, to lead this work. Over two years, the museums worked collaboratively to explore the legacies of empire and enslavement in their collections and to develop a programme of public-facing activities to engage new and existing audiences in meaningful and sustainable ways. Workshops and discussions enabled Sedgwick Museum staff to build their confidence and understanding in a supportive cross-disciplinary environment, and to test out ideas with peers from other museums. In parallel, the University of Cambridge Museums consortium also initiated a programme called Bridging Binaries, aimed at exploring and sharing LGBTQ+ histories in our museums. Informed by research by Dan Vo and Ellie Armstrong, the museums developed collections-based content for volunteer-led tours which challenged established heteronormative narratives (Armstrong 2022). As a scientific collection and with a staff team having little experience working in the humanities, the Sedgwick Museum found these collaborations to be hugely beneficial in developing a practice in researching and sharing stories that address silences and challenge established narratives about the collections.

The alternative narratives that we uncover have become embedded in conversations with our audiences; for example, they are incorporated into public tours, in-gallery schools teaching, careers talks, widening participation work with young people, and induction tours for academic colleagues. We have also installed audio labels accessed by QR codes (also available as podcasts on SoundCloud). The resulting discussions with a wide range of audiences enable the museum staff to explore personal assumptions and biases, broaden our understanding, and raise the profile of our work. Storytelling approaches are central to the promotion of social justice (Huhn and Anderson 2021); we explore themes of gender, class, power inequalities, the legacies of empire and enslavement, and stories of women, LGBTQ+ people, and People of Colour whose stories are not well known. Through collaboration with other Cambridge museums, we are part of a strong expertise-sharing network and can ensure that support is in place for staff when working with material that may be distressing. Work with creative practitioners also informs our understanding; the quotation from artist Rona Lee at the top of this article originates in research for her own creative practice. Her work is now (June 2024) the subject of a temporary intervention in the Whewell gallery. It challenges the overriding gallery narrative and invites discussion with visitors about the role of mineral displays. Longer term projects such as the redevelopment of the Whewell mineral displays thus benefit from a more reflective approach and can be informed by visitor discussions.

This context of substantial ambition but limited resourcing prompted the museum to look again at one of its most well-known and well-studied collections – the rocks, fossils, and minerals collected by Charles Darwin whilst on board HMS *Beagle* between 1831 and 1835. It enables us to challenge a range of established narratives and capitalize on the name of Darwin to draw more people into discussion about global extractive legacies.

3. Charles Darwin and the Sedgwick Museum

The substantial interest in Charles Darwin and the development of his theories is in part due to the extensive documentary archive he left behind. During the nearly five years he was away on the HMS *Beagle*, Darwin documented his activities and reflections in field notebooks, specimen lists, themed notes, a diary, and further notebooks with drafts of essays to be published on his return. In addition to the development of his theories, these notebooks capture a wide range of observations of the landscape, people, and wildlife that he encountered, and it is this valuable archival resource, much of which is held in Cambridge University Library as

well as being available online,⁴ that enables deeper investigations.

Darwin's enthusiastic and comprehensive notetaking can be linked back to his relationship with Adam Sedgwick, 24 years his senior. In Cambridge, Professors Sedgwick and Henslow recognized the potential in the young Darwin and sought to nurture and support his work. In August 1831, only a few months before his departure on HMS *Beagle*, Darwin spent time carrying out fieldwork in North Wales with Sedgwick. Sedgwick was interested in understanding the Welsh rocks in the context of establishing what came to be called the 'Cambridge system', while Darwin valued the opportunity to hone his field skills: 'This tour was of decided use in teaching me a little how to make out the geology of a country' (Barlow 1958: 70). Over the course of less than a week, Sedgwick taught him how to identify rocks, measure the orientation of strata, and develop generalizations from his field observations. Darwin learnt the importance of recording observations to return to later. Come December of the same year, Darwin sailed from Plymouth in HMS *Beagle*, the guest of Captain Fitzroy. He was to spend nearly five years on a journey which took him around the world, visiting South America, Tahiti, Australia, New Zealand, and Africa, along the way transforming not only his own thinking but scientific thinking about the natural world.

In 2009, as part of the Cambridge citywide celebrations to mark 200 years since Darwin's birth, the Sedgwick Museum opened a new permanent exhibition which explores Darwin's geological legacy. The exhibition includes around half of the approximately 2000 geological specimens collected by Darwin on the *Beagle* voyage, which were donated to the museum in 1897 by Darwin's nephew George Fox Darwin. The displays are popular with visitors, in particular international visitors, many of whom are seeking to engage with this important piece of scientific heritage and see it as part of their 'Cambridge Experience'.

3.1 'I a geologist'

As a young man, Darwin considered himself to be primarily a geologist; his peers felt similarly, and he described himself as such in his autobiography (quoted in Herbert 2005: 2). He was confident in mineralogy; his well-documented childhood interest in chemistry included an understanding of the properties of chemicals and minerals, and in Cambridge he was taught mineralogy by J.S. Henslow, William Whewell and William Hallows Miller, three successive holders of the Cambridge Professorship in Mineralogy.

In 1859, the same year as the momentous publication of *On the Origin of Species by Means of Natural Selection*, Darwin was also awarded the Wollaston Medal of the Geological Society. This medal was and still is the highest of the Society's awards, recognizing 'significant influence by means of a substantial body of excellent research' in geoscience.⁵ Accepting the medal on behalf of Darwin, who was unwell, Charles Lyell noted 'Mr. Darwin, ever since his great abilities became known by the "Researches during the Voyage of the *Beagle*," has never ceased to labour, even in spite of ill health, in the cause of geology' (Phillips 1859: xxv).

Herbert (2005) provides a wide-ranging and perceptive study of Darwin's development as a geologist and the central role he played in geological debate for more than 30 years. The 2009 displays in the Sedgwick Museum challenged what might be considered an established narrative of Darwin as primarily a biologist, demonstrating how important geology was in the development of his evolutionary interpretation of the fossil record.

Yet despite Herbert's (2005) comprehensive work on Darwin's geological research, the former makes no mention of the copper, gold, and silver mines in Chile and Argentina that Darwin visited during 1834 and 1835. Darwin collected specimens and reflected upon them in his notebooks in the context of regional geology, but the specimens' impact on geological thinking appears to have been minimal. We can assume that Herbert does not mention them because Darwin did not spend much time thinking about them geologically; mining does not substantially contribute to his reflections on geological structure and processes. However, through Darwin's observations, these specimens can point to a wider history of global trade and human exploitation.

3.2 The colonial context for the voyage of HMS *Beagle*

It is helpful to reflect on the reasons why Darwin was able to make this voyage. Before

coming to Cambridge, Darwin had spent a year at Edinburgh University studying with Robert Jameson on a course which covered mineralogy, geology, natural history, and meteorology. While Jameson's lectures were attended by a wide range of Edinburgh people, they were also popular with East India Company recruits preparing to leave for the colonies (Desmond and Moore 1991: 42); many of the collections Jameson used in teaching were collected by Navy survey ships from the colonies. Darwin was impressed and influenced by the writings of Alexander von Humboldt, whose *Personal Narrative* (1822) accompanied Darwin on the *Beagle* voyage (Humboldt 1822). Humboldt himself was trained in mineralogy and had worked as a mining engineer, inspiring his travel to the tropics.

When HMS *Beagle* departed in 1831, former Spanish colonies in South America had recently secured their independence, and the area was opening up to investment from American and other European countries. Accurate maps of the coastline would give the British an advantage as they raced to secure raw materials and resources in order to set up new markets for products (Desmond and Moore 1991). HMS *Beagle* was a Royal Navy survey ship, tasked with creating and cross-referencing accurate maps of the region. Distressingly, a further purpose of the voyage was for Captain Fitzroy to return three Indigenous Fuegian people from the Alakaluf and Yahgan tribes, named Orundellico, Yokcushlu and Elleparu (known to Darwin as Jemmy Button, Fuegia Basket and York Minster (McConnell 2004)).⁶ Fitzroy had captured them during a previous voyage and they had been sent to school in London to prepare them to contribute to setting up a mission in Tierra del Fuego. A fourth captive, whose name is not recorded but who was known as Boat Memory to the crew of HMS *Beagle*, had died of smallpox shortly after arriving in England.

In preparing for the trip, Robert Fitzroy wanted a naturalist companion of his own class, a gentleman with whom he would feel comfortable sharing conversation, cabin space, and mealtimes. The position was unsalaried, but this was not a barrier to Darwin's participation. While many of Darwin's letters home to his family have him regularly worrying about having to ask his father for additional funds – a problem that was particularly acute when he was travelling on land – money continued to be forthcoming from his family, and throughout his life he continued to live comfortably on the wealth of his, and his wife's families.

In reading Darwin's narratives, therefore, we acknowledge that this was not a neutral narrative, but one firmly framed within the context of empire, reflecting the power structures and privilege of a young, white, financially independent European. Despite biases, Darwin's writings are of crucial importance in revealing otherwise obscured histories and illuminating specimens in the museum's holdings.

4. Darwin in Chile

Having sailed from Plymouth in December 1832 and spent much time surveying the east coast of the South American continent, HMS *Beagle* rounded Cape Horn and in August 1834 arrived in Valparaíso, Chile. Darwin went ashore and lodged with Richard Corfield, an old schoolfriend who was a shipping agent (Browne 1996: 276) and who introduced him to other merchants in the town. Having purchased horses and hired local guides, he then set off on a six-week horseback journey into the Andes, one of several trips he made to take advantage of time available while Fitzroy and the *Beagle* were busy completing survey charts of the coast.

His notes and letters from these trips are rich with enthusiastic observations of the natural environment: its geology as well as his discoveries of fossil seashells and a petrified forest. On this trip, he hired *huasos* – Chilean horsemen – to accompany and guide him. Freed from the strictures of the ship's class system, Darwin embraced the freedom of sleeping outside as one of the *huasos*, although it did not stop him from describing them as 'vulgar' and 'ordinary' (Darwin 1845: 258).⁷ This trip was hugely important in helping Darwin develop his understanding of, and theories about, the geological history of South America and the formation of the Andes (Herbert 2005), in turn demonstrating his importance as a geological thinker and the contributions he was to make to the development of the science.

As with other parts of his trip, he came armed with letters of introduction from friends back home, as well as from contacts he met on the way; many of the up-and-coming managers and investors were British (Volk 1993). At Jajuel, he met the manager of the mine, describing

him as 'a shrewd but ignorant Cornish miner' for his lack of understanding of Latin (Darwin 1845: 259). He stayed a week and then continued eastward to Yaquil, where he visited another mine, this time as the guest of an American, Zacarias Nixon. Darwin had been given a letter of introduction to Nixon by Thomas Sutcliffe, an 'adventurer in South America' he had met in Valparaiso. Darwin dined with Mr Nixon, who showed him the mines.

On this trip, Darwin collected a number of specimens of copper, gold and silver ores and of the 'country' rocks in which they were found: 'the regular gold ore as dug out of the ground'. These are part of the Beagle Collection on display in the Sedgwick Museum. Here too, he made extensive notes on his observations, including one particularly striking specimen which provides a key point for expanding narratives. Specimen A2020 (Figure 1) is a near-spherical, golf-ball sized piece which he described as 'Copper pyrites, Gold, plumbago from Durarno mine'. Petrologist Alfred Harker's later description, in his catalogue of the Beagle Collection, confirms it to be 'wolfram chalcopyrite calcite ore'.



Figure 1: Beagle Collection specimen 2260.

Like most of the HMS *Beagle* specimens, none of these rocks and minerals are larger than a fist: Darwin was mindful that he had to share a cabin with his specimens and to pack them for shipping back to Cambridge. The specimen's quality and shape – it is a neat, near-spherical specimen – might lead us to infer that Darwin was given it as a souvenir rather than finding it on the ground.

4.1 Mine workers as observed by Darwin

Throughout this horseback journey, Darwin wrote in considerable detail about the labour conditions of the mine workers. While his observations were biased by his own experiences and situation, they nevertheless provide important glimpses into the working lives of the people extracting the precious and economically important metal ores. Darwin's focus was mainly on the labourers bringing the ore out of the mines; it is unlikely he directly encountered the

miners working wholly underground.

The young Darwin was clearly charmed by the 'rather picturesque' appearance of the Chilean mine workers he encountered, describing one's dress as

a very long shirt of some dark-coloured baize, with a leathern apron; the whole being fastened round his waist by a bright-coloured sash. His trowsers [sic] are very broad, and his small cap of scarlet cloth is made to fit the head closely (Darwin 1845: 339).

Despite their romantic appearance, the men carried out extremely onerous tasks: 'The labouring men work very hard. They have little time allowed for their meals, and during summer and winter they begin when it is light, and leave off at dark' (Darwin 1845: 260). Through Darwin's description of bringing the ore to the surface it is evident that it required considerable strength and resilience:

The mine is 450 feet deep, and each man brings up about 200 pounds [91kg] weight of stone. With this load they have to climb up the alternate notches cut in the trunks of trees, placed in a zigzag line up the shaft. Even beardless young men, eighteen and twenty years old, with little muscular development of their bodies (they are quite naked excepting drawers) ascend with this great load from nearly the same depth. A strong man, who is not accustomed to this labour, perspires most profusely, with merely carrying up his own body (Darwin 1845: 265).

Darwin also noted how in some mines where drainage technology was not yet available, the excess water was removed by men carrying it up the mine shaft in leather bags.

For this work, the mine labourers were paid twenty shillings a month with their food provided, while a miner working underground received twenty-five shillings a month. Food comprised 'for breakfast ...sixteen figs and two small loaves of bread; for dinner, boiled beans; for supper, broken roasted wheat grain' (Darwin 1845: 260). A throwaway comment, based on conversations with the mine managers, reveals a more shocking disregard for the humanity of these working people: 'They would prefer having bread alone; but their masters, finding that they cannot work so hard upon this, treat them like horses, and make them eat the beans'. Not surprising, given what we have read, is the lack of trust in the miners and the severe methods used to ensure security of the ore: 'Whenever the major-domo finds a lump thus hidden, its full value is stopped out of the wages of all the men; who thus...are obliged to keep watch over each other' (Darwin 1845).

Darwin was considerate of the conditions of the people he saw, writing how he 'was struck by the pale appearance of many of the men and enquired from Mr Nixon respecting their condition'. He recognized the inequality the workers experienced, with mine rules biased in favour of the owners and managers, but ultimately he blamed the workers themselves for their challenging conditions: 'they are unthrifty in their habits, and consequently poor'. He added, 'Bad as the above treatment of the miners appears, it is gladly accepted of by them; for the condition of the labouring agriculturists is much worse' (Darwin 1845: 337).

4.2 Chilean copper in global trade

all the large Chilian [sic] fortunes have been made by mines of the more precious metals. A short time since an English physician returned to England from Copiapó, taking with him the profits of one share in a silver-mine, which amounted to about 24,000 pounds sterling

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, Under the Command of Capt. Fitz Roy, R.N.*, (1845: 346).

Darwin, as was also the case with other European travellers in South America at the time, clearly understood the financial opportunities that these mines were affording. But his observations

also tell a richer story of the global potential of Chilean copper mines. He was familiar with mines in England and Wales and was surprised on visiting the Jajuel mine that the peace of the mountains was undisturbed by the noise and sight of engines and machinery that were associated with similar activities in England. This, he noted, was because 'it is found more profitable, on account of the extreme scarcity of firewood, and from the Chilian [sic] method of reduction being so unskilful, to ship the ore for Swansea' (Darwin: 1845).

This comment makes a much more direct connection between the origin of this specimen in the mountains of Chile, right back 'home' to Britain. It highlights that during the 1820s and 30s, many tonnes of rock were being shipped more than ten thousand miles around Cape Horn and across the Atlantic to be smelted almost on the doorstep of Darwin's family home – and with no doubt as to where the profits were being channelled. South Wales was, at the time, the world centre of copper and brass production, with ore being imported from Cuba, Mexico, Columbia, Peru, and Australia as well as from Chile for processing in Swansea. Well placed for Atlantic trade routes, the town was known from the late 1700s until the 1840s as 'Copperopolis' (Evans and Miskell 2020). Further incentives for trading in copper ore came from the recently passed Customs Act of 1827, which enabled the practice of 'smelting in bond'. As Newell (1990) notes, this meant that imported copper ore was not liable for duty if it were to be re-exported as processed copper.

The connections the highlighted *Beagle* Collection specimen can make go beyond a simple relationship between Chile and South Wales. Through its trade, copper connects continents through both time and space, and in the context of empire, contrasts with the global trade in consumer goods such as sugar, tea, rum, ceramics and fabric. The metal is a key ingredient in industrialization and in the large-scale exploitation of people. Copper long played an important role in Euro-African exchange, from sixteenth century Portuguese expeditions throughout the period of the Atlantic slave trade. At the time that Darwin was writing, sugar was refined on Caribbean plantations by boiling in large copper bowls over open fires, and rum produced using copper stills, all enabled by the labour of enslaved Black people. Later industrial developments required copper for steam locomotives and then in the development of international telegraph communication.

Thus a single specimen enables us to glimpse a much wider picture than Darwin might have envisaged, one that tells of the triangular trade across the Atlantic and the British role in the exploitation of both human and natural resources. Indeed, copper sheathing fitted to the bottoms of ships (including HMS *Beagle*) was known to prevent fouling by marine organisms and made the ships faster and more manoeuvrable, an advantage rapidly adopted by slave traders to reduce death rates on the horrific Middle Passage (Solar and Ronneback 2015).

5. Discussion: telling the stories of this specimen

How then, can these powerful stories become part of the experience of both staff and visitors in the museum? Understanding and sharing knowledge of the legacies of empire in our collections is central to ensuring a plurality of voices in the museum, and hence in beginning to remove the barriers that many people have experienced, both in the museum and within Earth sciences. Of key importance is ensuring that these are narratives with relevance to our visitors' lives, whether they are young people visiting with a school, students working on a placement, or families visiting together.

Since 2021, the story of Darwin's chalcopyrite specimen has been included in the training that front of house staff and volunteers receive, specifically to build their confidence to engage visitors with what might be considered more challenging narratives. It is also included in tours and talks, and more recently, a QR code enables visitors to access an audio label which explores some of the ideas in this paper.⁸

When telling this story of the Chilean mine workers in the museum, we provide our visitors with reference points to help root this narrative in their own experiences and to create points of connection and empathy. The 91kg loads carried by the miners are the equivalent of carrying a person of above average weight, on your back, up a ladder, all day. A recent experimental study (Chen et al. 2022) involving coal miners carrying one-handed (as would be likely when climbing a ladder) recommended that workers engaged in this type of manual

handling on a daily basis should not carry more than 22kg on the back or legs to prevent the development of musculoskeletal disorders.

Many older visitors remember the high profile mine accident that took place at the San Jose gold and copper mine in Copiapó, Chile, in 2010, and this too provides a key point of reference and starting point for discussion. Thirty-three miners were trapped underground for 69 days before being rescued in an operation that was extensively reported in the global media.⁹ A 2011 enquiry placed blame for the collapse on the mine owners and on Chile's Servicio Nacional de Geología y Minería. The rescued miners were the subject of high-profile media coverage, but many have since experienced significant mental health impacts. Opening up discussion with visitors to reflect on the traumatic experiences of these miners enables visitors to empathize with the everyday experiences of the nineteenth century workers that Darwin encountered. This can also prompt a wide range of responses rooted in lived experience, including for example, the economic impacts of coal mining in the UK, of family and cultural connections to Chile, and of experiences of claustrophobia when spending time underground. These powerful emotional responses demonstrate effectively how human stories can be brought firmly back to visitors' experiences of these specimens.

Chile remains the world's largest copper producer with an output of more than 5.5 million tonnes in 2022.¹⁰ This represents around a quarter of global production, and more than twice that of Peru, the second largest producer. Most of the production is owned by Codelco, the Chilean state mining company,¹¹ but the next four top producing companies all have British ownership interests. When this is included in discussions with museum visitors, many find this surprising and it prompts them to reflect on who controls and profits from other natural resources. Copper is still mined in the districts that Darwin visited, but in vast opencast and highly mechanized 'mega mines', including the world's largest open pit mine, Chuquicamata, in the north of the country. Processing the ore requires enormous quantities of water, a precious commodity in the high Andean deserts, and as a result Chile is facing increasing challenges around the environmental impact of copper extraction. Furthermore, Chile has the largest global reserves of lithium, a critical mineral in energy transition, and so the country's resource economy will play an important role in sustainable global futures.

Charles Darwin's groundbreaking voyage on HMS *Beagle* was of central importance to the development of science, and the Sedgwick Museum is proud to be able to tell the story using the specimens that Darwin himself collected. But the museum also welcomes the opportunity to explore different narratives and to use the Darwin name to draw them to the attention of a wide range of visitors. From a place where many mineral specimens exhibit a strong 'museal silence', these specimens can be used to bring to the fore the stories of the people that extracted them, and whose lives were impacted by this across several continents.

Looking to the future, the Sedgwick Museum has long-term plans to redevelop the displays of minerals in the Whewell gallery, to bring the human aspects of these collections to the fore, and to enable discussions about the roles of these materials in both the past and the future. This project has acted as a pilot in building staff confidence and skills, and in identifying how the stories can be shared. In a context where capacity and resources are limited, focusing the narrative on a small number of specimens and using existing documentary material are practical yet powerful ways to engage museum visitors with the global nature of the museum's collections and with the human stories that underlie the international economic networks that existed during the first half of the eighteenth century. In this way, the museum can play an important role in creating an Earth science that is equitable, inclusive and relevant to future global citizens.

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Notes

- 1 Part of Lee's Developing Your Creative Practice project, Lithic Entanglements, funded by Arts Council England.
- 2 Also noting here that of the 191 minerals named between 2017 and 2019, 5 per cent were named after women and 49 per cent after men (Anon. 2022).
- 3 University of Cambridge, 'Advisory Group on Legacies of Enslavement Final Report', 2022. <https://www.cam.ac.uk/about-the-university/advisory-group-on-legacies-of-enslavement-final-report>, accessed 29 January 2024.
- 4 See John van Wyhe, 'The Complete Work of Charles Darwin Online', 2002. <http://darwin-online.org.uk/>, accessed 29 January 2024.
- 5 Geological Society of London, 'Wollaston Medal'. <https://www.geolsoc.org.uk/About/Awards-Grants-and-Bursaries/Society-Awards/Wollaston-Medal>, accessed 29 January 2024.
- 6 Further information about the Fuegians can be found on the Darwin Correspondence Project website: see <https://www.darwinproject.ac.uk/yokcushlu-fuegia-basket> and <https://www.darwinproject.ac.uk/boat-memory>, accessed 29 January 2024.
- 7 Darwin's Journal of Researches is available online: see <http://darwin-online.org.uk/content/frameset?itemID=F14&viewtype=text&pageSeq=1>, accessed 29 January 2024.
- 8 This is also available as a short podcast here: <https://soundcloud.com/univ-of-cambridge-museums/darwins-chalcopyrite>, accessed 26 July 2024.
- 9 Claire Provost, 'Chile Miners: Rescue Joy Must Not Derail Focus on Why Mine Collapse Happened', *The Guardian*, 13 October 2010. <https://www.theguardian.com/global-development/poverty-matters/2010/oct/13/chile-miners-rescue-mine-collapse>, accessed 29 January 2024.
- 10 Daniel M. Flanagan, 'Copper', US Geological Survey, Mineral Commodity Summaries January 2023. <https://pubs.usgs.gov/periodicals/mcs2023/mcs2023-copper.pdf>, accessed 29 January 2024.
- 11 Mining Technology, 'Copper Production in Chile and Major Projects', 2023. <https://www.mining-technology.com/data-insights/copper-in-chile/>, accessed 23 June 2024.

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