# Cataloguing Minerals, Part One: Historical Cataloguing Practices and the Logics of Colonialism

*Selby Hearth[1,A], Carrie Robbins[1,A], Marianne Weldon[1,A], Aha Anderson[1], Rosa Bieber-Stanley[1], April Chernila[1], Helen Christ[1], Hannah Cosgrove[1], Morgan Hanson-Rosenberg[1], Carly Hill[2], Maya Hofstetter[1], Emily Lazo[1], Izzie Ludlow[1], Samantha Lyster[1], Rachel Myers[1], Jasper Nash[1], Georgia Reed[1], Julia Saint-Amour[1]*

[1] *Bryn Mawr College, Bryn Mawr, PA, USA 19010*

[2] *Haverford College, Haverford, PA, USA 19041*

[A] *Positionality (as declared by authors): U.S.-born settler*

## Abstract

Mineral wealth has motivated and funded extractive empires, often at the expense of local communities, workers, natural environments, and public health. Yet those connections are not recorded in traditional mineral catalogues, which divorce specimens from context. This article examines the roots of those omissions and situates mineral cataloguing in the larger body of literature on knowledge organization systems and their relation to power. We examine how colonial ideologies of land and people become entrenched in mineral cataloguing practices, and how this reinforces the ways that contemporary geologists think about their work. We argue that revising mineral cataloguing practices is a necessary first step – both practically and epistemologically – toward addressing histories of violence in our mineral collections and the science of geology.

**Keywords**: minerals; colonialism; cataloguing; pedagogy

## Short biographical statement

The authors of this paper are the students and faculty involved in the 360° 'Minerals, Museums, and Western Colonialism' programme at Bryn Mawr College, near Philadelphia, Pennsylvania, USA. Hearth is an Associate Professor of Geology and manager of the Bryn Mawr mineral collection. Robbins is Curator/Academic Liaison for Art and Artefacts in Special Collections. Weldon is the Collections Manager for Art and Artefacts in Special Collections. Anderson, Bieber-Stanley, Chernila, Christ, Cosgrove, Hanson-Rosenberg, Hill, Hofstetter, Lazo, Ludlow, Lyster, Myers, Nash, Reed, and Saint-Amour were undergraduate students at Bryn Mawr or Haverford Colleges at the time of the course.

## Introduction

Bryn Mawr College near Philadelphia houses more than 40,000 mineral specimens. For most of these, their extraction was inextricably entwined with labour, land, environment, public health, colonialism, and/or imperialism (see for example Das and Lowe 2018, Gelsthorpe 2021, and Hearth and Robbins 2022). This is not unique to Bryn Mawr; it is the reality of mineral collections. Mineral wealth has motivated and funded occupations of Indigenous lands since the beginning of the Western colonial era: for example, Spanish silver, South African diamonds, South American copper, Australian opal, and gold from dozens of sites (Raji et al. 2023). To extract these minerals, Western colonizing governments and the corporations they partnered with have often relied on exploitative labour practices, including forced or

enslaved labour (Borucki et al. 2015; Reséndez 2017). Industrial mining has also produced extensive environmental damage, some of which negatively affects public health for decades or centuries. These public health impacts are disproportionately borne by Indigenous and other historically marginalized communities, particularly racial minorities (Liboiron 2021a). These issues are not from the past; they still exist today. The Diné (Navajo Nation) are fighting for cleanup of their lands polluted by uranium mining in the 1950s (Fegadel 2023).[1] In the Democratic Republic of Congo, children still work in Western-owned cobalt mines, in which labour conditions are extremely dangerous and often deadly.[2] The Fond du Lac Band of the Lake Superior Chippewa are currently fighting against a federally-issued permit that would allow the PolyMet copper-nickel mine to destroy their wetlands.[3]

Such histories brought mineral specimens to our collections. As curators today, what do we *do* with them? How should we care for these objects and their stories? How should we use them? *Should* we use them? What justice is possible here, and what capacity do we have to contribute to it? The first step toward answering any of these questions is to name or explicate the histories (Alberti 2005). This might include: 1) finding the sources of the specimens; 2) identifying the people and communities involved in and affected by their extraction; 3) studying and discussing how the specimens' extractions were tied to broader regimes of power such as colonialism, imperialism, white supremacy, enslavement, forced and exploitative labour, and environmental pollution; and, 4) investigating how these extractions were implicated in the production of geologic knowledge.

In attempting to explicate these histories, we – like most mineral curators – run into a serious problem: the minerals' acquisition records are incomplete. In collections, catalogue records are the repositories of all information that the cataloguer considers meaningful about a specimen (Bowker and Starr 2000). Catalogues therefore not only reflect the worldview that produced them, they *reinforce* that worldview, and they also shape future actions (Turner 2020). Standard mineral catalogues omit the human and ecological context of the specimens because these details have not been valued. Continuing to replicate such cataloguing traditions teaches new generations of geologists and curators that human and ecological impacts are unimportant, and in doing so perpetuates colonial and racist practices. This further limits our ability as curators and scientists to respond to the human and ecological conditions of mineral extraction. The project at Bryn Mawr advocates for rebuilding human and ecological contexts into mineral catalogues as a first step toward confronting the legacies of oppression and violence that brought so many of these minerals into Western collections. We undertake this effort in two parts: in this article ('Part One'), we argue that restructuring the practices of mineral cataloguing is essential for addressing social and psychological violence perpetrated by our collections and our science more broadly. We begin by situating mineral cataloguing within a larger body of literature that focuses upon how knowledge organization systems reinforce power structures. We examine the relationship of mineral cataloguing to decolonization efforts, and the roles that cataloguing plays in specimen creation and worldview reinforcement. We then apply these perspectives to 99 years of cataloguing at Bryn Mawr College to illustrate how the day-to-day practices of mineral cataloguing reinforce the logics of colonialism and imperialism. In a follow-up article (Part 2, Robbins et al. 2024: 29-42), we begin to reimagine what a mineral catalogue could be, envisioning an expanded user base that includes not just mineralogists but activists, contemporary communities with cultural or historical relationships to these materials, descendants of mineworkers, and geologists looking to understand the historical relationships between our science and broad social processes such as colonialism. We anticipate and describe some of the many risks and practical limitations that arise when attempting to undertake this kind of work.

## Cataloguing and 'Decolonization' in Geology and Museums

This article's work relates to larger, ongoing examinations of the relationships between geology and Western colonialism and imperialism. Minerals, rocks, fossils, and land are the raw materials from which geologic ideas are extracted, and it is these materials and their resulting knowledge that have fuelled and funded extractive empires (Liboiron 2021a, 2021b; Yusoff 2019).[4] The work presented in this article also relates to an ongoing examination of the

roles of museums in perpetuating Western colonialist and imperialist outlooks, as well as their underlying racist ideologies (Ashby and Machin 2021; Autry and Murawski 2017; Barringer and Flynn 1998; Das and Lowe 2018; Edwards and Mead 2013; Grimme 2020; Phillips 2022; Scott 2007; Simpson 1996).[5] Some of this work gets described as decolonization. However, not all studies that *examine* colonial relationships constitute decolonial projects. In the context of US settler-colonialism, Tuck and Yang (2012) have argued that decolonization requires the material undoing of colonization, that is to say, the 'repatriation of Indigenous land and life' (Tuck and Yang 2012: 1). Under this definition, most 'decolonial' projects – including the cataloguing project described here – should not be labelled as decolonizing. A revised cataloguing system might enable future work that is materially decolonial by preserving contexts and histories that would otherwise be lost – but it is not itself material repair.

Critiques of Tuck and Yang's material decolonial framework have pointed out that colonialism has not been a strictly material process. Colonization has been made possible by particular ideologies; it has sought to subjugate and destroy non-European epistemologies (de Sousa Santos 2014); it has operated both physically and socially (Hauskeller et al. 2023), and therefore entwines the material and the symbolic (Garba and Sorentino 2020). Through this lens, a revised mineral cataloguing practice has the potential to deny a single-perspective assignment of meaning to minerals, to conceptually reconnect minerals to their human and ecological contexts, and to systematize the relinquishment of narrative control. In this article, we follow the example of Melissa Adler, who described cataloguing as an opening for 'repair and creativity':

> Understanding and coming to terms with painful histories is at the heart of all these reparative projects…'Repair' does not refer to a correction of legacies of wrong-doings, but rather, it is a matter of truth-telling, accountability, negotiation, redistribution, and redress (2016: 631).

Naming and preserving specimen extraction histories could enable future reparative actions. In the meantime, knowing the trajectories of these specimens enables curators to share more human- and ecologically-centred histories, moving beyond the old display traditions of 'Marvel!' and 'by chemical class' summarized by Hearth and Robbins (2022). For example, the Manchester Museum has been researching and installing displays that highlight the human histories of their specimens (Gelsthorpe 2021), and the Beyond Extraction collective installed an audio 'Counter-Tour' at the Royal Ontario Museum's Teck Suite of Galleries.[6] Whether they were created by curators, activists, or artists, these interventions require specimen histories, which are dependent on cataloguing practices that preserve this information. The revised mineral cataloguing practice summarized here is not a materially decolonial project. However, we believe it to be necessary labour in the hope of future material repair.

## Cataloguing: Specimen Creation and Worldview Reinforcement

Cataloguing is not simply an act of bookkeeping, it is a process through which raw materials turn into *specimens* and are assigned meanings. A curator cataloguing a mineral might file it under '7.AD.35' in the Nickel-Strunz classification system; in that small entry, they have assigned it a name (barite), a chemical formula ($BaSO_4$), a relationship to all other minerals also based on the $SO_4$ group, a known crystal structure, crystal class, space groups, growth habit, growth environment, lustre, hardness, cleavage patterns, fracture patterns, density, specific gravity, optic sign, and birefringence (capacity to split light). Even the length of the bonds between the atoms in that specimen are now known. With '7.AD.35' assigned, the object is no longer just a chunk of earth; it has been given a place within larger systems of knowledge.

This assignment is an active process that requires a cataloguer to develop an understanding of the relationships between objects and then to impose that understanding onto them, an exercise that Hannah Turner calls 'formative' and 'world-building' (2017: 473). For minerals, modern cataloguers usually impose frameworks of chemistry and locality, understanding a mineral as both defined by its chemical composition ('$BaSO_4$'), and as representative of geological processes operating at its extraction location.

**Cataloguing is Guided by Invisible Worldviews**

Cataloguing assigns meaning, but not all information 'counts' as meaningful to a particular cataloguer. For example, nineteenth-century mineral catalogues often recorded the mine that a mineral was extracted from, but not which plants were observed growing atop the deposit. There is an obvious reason for this: at the time, such information was not considered scientifically important. Yet contemporary geobiologists are intensely interested in the relationships between bedrock mineralogy, soil chemistry, ecosystem diversity, and microbial endolithic communities that feed on mineral deposits. What is considered meaningful about a given specimen changes through time and across cultures, because meaning is rooted in our worldviews, epistemologies, and understandings.

Modern cataloguing standards were developed for minerals (and other geologic materials) in the 1970s by the Geological Curators Group (GCG), and the Museum Documentation Association (MDA). Early discussions around mineral cataloguing focused for example on: standardizing fields for geologic specimen entries; transferring records to punch cards for computerization (Roberts and Jones 1975); documenting the processing and analysis of specimens within a collection (Roberts 1986: 478); making geological data available to a wide audience (Price 1986: 481); and continuing uses for old paper labels (Cleevely 1986: 483). Emerging from these discussions, the GCG and MDA published the *Geological Record Centre Handbook* (Cooper et al. 1980), and the GCG published *Guidelines for the Curation of Geological Materials* (Brunton et al. 1984). These documents gave instructions for mineral acquisition, preservation, and documentation, as well as the handling of hazardous specimens. The Society of the Preservation of Natural History Collections adopted documentation best practices for geological specimens in 1988 (Fitzgerald 1988) and for natural history specimens more broadly in 1994 (Cato 1994). Similarly, the Natural Sciences Collections Association published a documentation standard in 1999 that updated processes to include technologies such as bar codes and electronic databases (Carter and Walker 1999). Although they are continually updated to incorporate changing search technologies, the content of these cataloguing systems remains immersed in the intellectual traditions of the Scientific Revolution. They focus on mineral identification, chemical class, crystal structures, locations, and scientific analyses.

These catalogue fields are descendants of the eighteenth- and nineteenth-century European push to document all of nature. Inspired by the tenets of the Enlightenment and the Scientific Revolution, which enshrined reason and required conclusions to be based on observations, natural historians of that era believed that only by examining nature could they hope to understand it. They gathered everything they could reach into scholarly collections that grew out of the Renaissance 'cabinets of curiosity' or 'wunderkammer' (Impey and MacGregor 2000). In these collections they described specimens, named them, ordered them, and reordered them. Each catalogue embodied its maker's views of how minerals related to each other. Thus, these catalogues represented more than just records – they were tools for *thinking* about minerals (Knell 2000: 10; Hearth and Robbins 2022: 6-8).

This Enlightenment drive to order all of nature assumed that nature itself was chaotic, and that it was the job of 'Man' (white, European, propertied, educated males) to extract understanding from it. Mary Louise Pratt argues that these early natural historians saw the world as actual chaos – plants, animals, minerals brought together in a hodgepodge – and that it was scientists' role not just to *observe* order but to *produce* it:

> Natural history called upon human intervention (intellectual, mainly) to compose an order. The eighteenth-century classificatory systems created the task of locating every species on the planet, extracting it from its particular, arbitrary surroundings (the chaos), and placing it in its appropriate spot in the system (the order-book, collection, or garden) with its new written, secular European name…. One by one the planet's life forms were to be drawn out of the tangled threads of their life surroundings and rewoven into European-based patterns of global unity and order (2008: 31).

Natural historians subjected rocks, minerals, and fossils to the same untangling: hammering

them first out of the ground and then into the invisible infrastructures that still govern mineral cataloguing today. And because those systems arose from imperialist worldviews that saw nature and people as resources to be exploited for profit, they continued to silently perpetuate and reinforce those worldviews. David Garneau draws a line directly between observation and extraction:

> The colonial attitude is characterized not only by scopophilia, a drive to look, but also an urge to penetrate, to traverse, to know, to translate, to own, and exploit. The attitude assumes that everything should be accessible to those with the means and will to access them; everything is ultimately comprehensible, a potential commodity, resource, or salvage (2016: 23).

## Cataloguing and the Logics of Imperialism

> Colonialism and white supremacy have always been relational projects. They rely on the logics of sorting, ranking, and comparison that produce and naturalize categories of racial difference necessary for the legitimation of slavery, settler colonialism, and imperial expansion (Molina et al. 2019: 3).

Collecting has not been merely a scientific enterprise. Many large, state-run, eighteenth- and nineteenth-century Western natural history collections have been explicitly colonial projects, each one a 'three-dimensional imperial archive,' as Tim Barringer calls them (1998: 11). Western collectors have framed this as bringing natural objects from the perceived 'peripheries' of the world to the so-called centre, employing a binary logic that was long used but only named by postcolonial theorists of the 1990s. This powerful logic continues to allow the Western imperium to insist on itself as central, while rendering all other parts of the world as marginal (Ashcroft et al. 2002; Azoulay 2019; Chakrabarty 2008; Spivak 1988). When they were first amassed, such collections were intended to embody the military and commercial reach of a nation: Napoleon, for example, ordered mineral specimens from land that French armies had captured (Vogel 2015), and Thomas Jefferson tasked the Lewis and Clark Expedition with returning natural history specimens from the territory mapped in the Louisiana Purchase (Conn 1998). These specimens flowed to metropoles not only as evidence of potential extractables and as symbols of professed ownership, but also as testaments of intellectual reach. Imperial governments and individual naturalists alike embraced the connection between European domination and the power to define the natural world. Curator John Edward Gray, for example, used his cataloguing of the British Museum's natural history collection to position his country as intellectual arbiter of the natural world:

> For its political patrons, the [British Museum] was an imperial project: to display the magnificence, the omniscience, of the British Empire and the omniscient knowledge such powers implied. Natural history was more than a matter of scientific or aristocratic curiosity. It was one of national pride. The ability of the British metropolis to amass, name and classify the world's population of natural inhabitants would, in the eyes of its patrons, exemplify British imperialism's brilliance in the post-Napoleonic period. With that in mind, Gray's catalogues of the natural history collection of the British Museum were more than mere inventories of the collections under his care—they were to be exhaustive accounts of all the known members of any natural order, a true ground for a *systema naturae* of all the world's living inhabitants brought under an imperial gaze (McOuat 2001: 6).

This assembly of a *system naturae* was a fundamentally extractive enterprise. Natural specimens were removed from the human and environmental context in which they existed, shipped back to Europe or large US cities, then classified and catalogued based on 'universal' descriptive standards and taxonomies that Westerners had developed. Scientists could then perform analyses to extract more information from these specimens, using that data to build the conceptual foundations of the modern disciplines, which were also imbued with Western perspectives and values. For example, Arthur Holmes famously reset the known age of the

Earth by analysing uranium-bearing crystals from Sweden, the USA, and Ceylon (Sri Lanka), which had been sent to the British Museum (now the Natural History Museum in London; Holmes 1911). Pioneering tectonics researcher Eduard Suess developed his concept of Gondwanaland by analysing data his explorer friends sent him from India, Australia, South Africa, and the East African Rift (Chakrabarti 2019).

Cataloguing, naming, and organizing the botanical world was necessary for the plantation economies that European powers operated in the Americas using the labour of enslaved people (Brockway 1979; Schiebinger and Swan 2007). Similarly, systematically cataloguing, naming, and organizing fossils and rocks powered coal prospecting and extraction, which pumped literal fuel into the Industrial Revolution. In essence, the ideologies of collection and cataloguing both arose from and enabled industrialization.

Today, the taxonomic frameworks in natural history cataloguing perpetuate and reinforce the worldviews of an industrializing, colonizing nineteenth-century Europe. Cataloguing determines which information gets preserved, and which is left to die out: the name of the collector is catalogued, but not the name of the miners who opened the Earth for the collector to walk in. The location of the specimen is recorded, but not the land rights dispute between Indigenous communities and colonizers at the time the mineral was taken.

For minerals in particular, imperialism is tied to extraction of land and labour. Minerals are tiny chunks of land. The ways that nineteenth-century geologists thought about, categorized, and collected minerals was related to how they treated land. Valuable land was to be extracted and shipped away; land without value could be the repository of pollutants created from that extraction (Liboiron 2021a). Labour was the tool to be used to accomplish that transformation.

In this project, we experiment with how to recognize extraction legacies through the cataloguing of a single specimen in Bryn Mawr's Mineral Collection: V.4476, a piece of azurite and malachite from the Tsumeb Mine in what was South-West Africa and is now Namibia. We begin by examining how this specimen has been catalogued in our collection through time. In a follow-up essay (Robbins et al. 2024: 29-42), we re-envision how it *could* be catalogued.

**99 years of cataloguing V.4476**

V.4476 is housed in the George Vaux Jr. mineral collection, an assembly within the broader mineral collection at the college. The Vaux collection consists of approximately 10,000 mineral specimens gathered from the mid-1800s to early 1900s by Philadelphia mineral collector George Vaux Jr. and donated to the college by his family in 1953.[7]

The oldest surviving catalogue records for V.4476 are the tags that Vaux hand-wrote, presumably in 1925, when he added this mineral to his collection. These tags accompanied each specimen in his storage trays, and included minimal information – usually the mineral's name and location on one side, and, on the other side, a code or name for his source, the date of acquisition, and another code, possibly indicating the specimen's value (Figure 1).

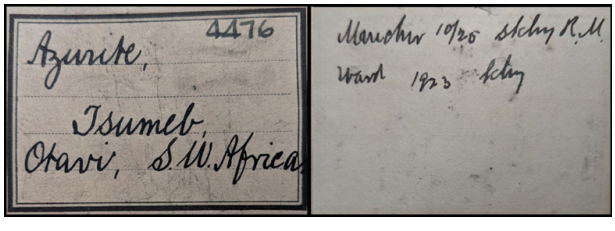


*Figure 1: Original specimen tags hand-written by George Vaux in 1925. The front of the card (left) reads 'Azurite, Tsumeb, Otavi, S.W. Africa'. The accession number (4476) was written in 1958 (it matches the handwriting of Harold Arndt, see text). The back of the card (right) reads in Vaux's handwriting: 'Maricher 10/25 slchy R.M. Ward 1923 bchy'.*

These cards were the only documentation accompanying the collection upon its arrival at

Bryn Mawr's Geology Department in 1953. At that point, the college hired a retired mining engineer, Harold Arndt, to serve as a part-time curator of the growing mineral collection. In 1958 he transcribed the information from the original specimen tags into a handwritten ledger (Figure 2A). The ledger consisted of mimeographed forms with only four columns for information: 'Number,' 'Specimen,' 'Locality,' and 'Value.' This transition marked a shift from open-field specimen tags to form-based catalogue entries with predefined fields.

Upon Arndt's death in 1979, the college hired an alumna of its Geology Master's degree programme, Juliet Reed, as a part-time curator of the collection. Reed re-catalogued the collection with a typewriter. She used the same mimeographed forms that Arndt had used, reproducing the same categories (Figure 2B).

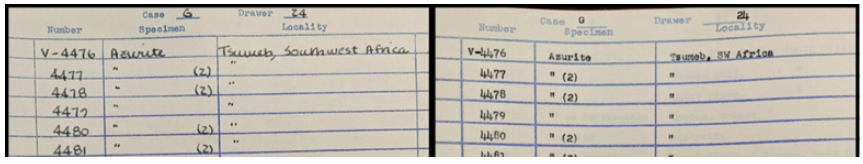


*Figure 2: Left: Hand-written ledger produced by Harold Arndt in 1958. Right: typed ledger produced by Juliet Reed between 1979 and 2009. Both catalogues are opened to the V.4476 entry.*

Reed also assembled a card catalogue: 'Vaux Coll. by Countries (+US by States)', although she entered African and South American specimens by continent only (Figure 3).

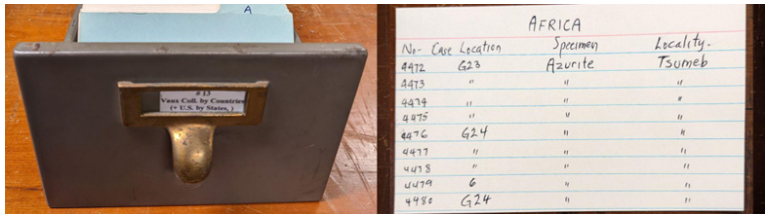


*Figure 3: Vaux Collection sorted by geography in a card catalogue produced by Juliet Reed between 1979 and 2009. V.4476 listed on the card at right.*

In the summer of 1995, Reed hired an undergraduate to re-catalogue the collection in the electronic database system Paradox. The files have since been corrupted and cannot be opened. The information was not lost, however. Presumably at some point after 1995, Reed transferred (or possibly exported) the Paradox database into a Microsoft Excel file. She added a range of new fields related to provenance and mineralogy, for example 'New Loc Name' for localities whose names had changed and 'Formula' for each mineral (Figure 4).

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Key | Spec. | Very Good | 1981 $ | Hall Case;Rm, Case, Dwr | Missing, Traded | Group | Major Min | Mineral Names | Var | Old Name | Mine/ Quarry | Town/ Dist | County/ Dist | State | Country | New Loc Name | Type Locality | . of Specimens | Formula | System |
| 5655 | 6019 | 4471 | v.g | | | | | * | Azurite | | | | Tsumeb | Otavi Dist. | | S.W. Africa | Namibia | | | Cu3(CO3)2 | mono |
| 5656 | 6020 | 4472 | v.g. | | | | | * | Azurite | | | | Tsumeb | Otavi Dist. | | S.W. Africa | Namibia | | | Cu3(CO3)2 | mono |
| 5657 | 6021 | 4473 | | | | | | * | Azurite | | | | Tsumeb | Otavi Dist. | | S.W. Africa | Namibia | | | Cu3(CO3)2 | mono |
| 5658 | 6022 | 4474.1 | | | | | | * | Azurite | | | | Tsumeb | Otavi Dist. | | S.W. Africa | Namibia | | 2 | Cu3(CO3)2 | mono |
| 5659 | 6023 | 4474.2 | | | | | | | Azurite | | | | Tsumeb | Otavi Dist. | | S.W. Africa | Namibia | | | Cu3(CO3)2 | mono |
| 5660 | 6024 | 4475 | | | | m | | * | Azurite | | | | Tsumeb | Otavi Dist. | | S.W. Africa | Namibia | | | Cu3(CO3)2 | mono |
| 5661 | 6026 | 4476 | v.g | | | | | * | Azurite | | | | Tsumeb | Otavi Dist. | | S.W. Africa | Namibia | | | Cu3(CO3)2 | mono |
| 5662 | 6025 | 4476 | v.g | | | | | | Malachite | | | | Tsumeb | Otavi Dist. | | S.W. Africa | Namibia | | | Cu2(CO3)( | mono |
| 5663 | 6027 | 4477.1 | | | | m | | * | Azurite | | | | Tsumeb | Otavi Dist. | | S.W. Africa | Namibia | | | Cu3(CO3)2 | mono |

*Figure 4: Ca. 2000 Microsoft Excel catalogue for V.4476. There are now two rows with entries to indicate the two minerals present: azurite and malachite (highlighted).*

Table 1 compares the information recorded by each of these re-cataloguing efforts.

| | 1925 tag[1] | 1958 ledger[2] | 1979 ledger[3] | Card Catalog[4] | ~2000 spreadsheet[5] |
|---|---|---|---|---|---|
| **Mineral Name** | 'Azurite' [6] | 'Azurite' | 'Azurite' | 'Azurite' | 'Azurite' and 'Malachite' |
| **Number** | '4476' | 'V-4476' | 'V-4476' | '4476' | '4476' |
| **Locality** | 'Tsumeb, Otavi, S.W.Africa' | 'Tsumeb, Southwest Africa' | 'Tsumeb, SW Africa' | 'Tsumeb' | 'Tsumeb, S.W.Africa, Namibia' |
| **Source** | Maricher via Ward's | No field | No field | No field | No field |
| **Date of acquisition** | 10/1925 from Maricher, 1923 from Ward's | No field | No field | No field | No field |
| **Value** | Encoded: '*slchy R.M*' and 'bchy' | Field present, no entry | Field present, no entry | No field | Field present, entry present |
| **'Key'** [7] | No field | No field | No field | No field | '6026' |
| **'Very Good'** [8] | No field | No field | No field | No field | 'v.g.' |
| **'Missing, Traded'** | No field | No field | No field | No field | Field present, no entry |
| **'Group'** | No field | No field | No field | No field | Field present, no entry |
| **'Major Min.'** [9] | No field | No field | No field | No field | Azurite is given the * |
| **'Var.'** | No field | No field | No field | No field | Field present, no entry |
| **'Old Name'** | No field | No field | No field | No field | Field present, no entry |
| **'Type Locality'** | No field | No field | No field | No field | Field present, no entry |
| **'No. of Spec'** | No field | No field | No field | No field | Field present, no entry |
| **'Formula'** | No field | No field | No field | No field | 'Cu3(CO3)2' |
| **'System'** | No field | No field | No field | No field | 'mono' |

*Table 1: Cataloguing fields for V.4476*

Notes on table:

1 Specimen tag: Small card, handwritten in ink, stored with specimen. Written by Vaux in 1925.

2 Hand-written ledger: Mimeographed form pages printed, then hand-written entries in ink. Written by Arndt in approximately 1958.

3 Typed ledger: Mimeographed form pages printed, then entries typed in with a type-writer. Presumably created by Reed between 1979 and 2009.

4 Card catalog: Index cards, hand-written in ink, sorted by geography. Presumably created by Reed between 1979 and 2009. Reed's handwriting.

5 Excel spreadsheet: Created by Reed between 1995 and 2009.

6 The mineral name was listed as 'Azurite,' even though it is not the dominant mineral. Most of the specimen is a green mineral, possibly malachite.

7 Unknown what Reed's 'Key' field was.

8 'Very Good' indicated specimens that Reed thought were 'very good' for some reason. They were marked with 'v.g.'.

9 An asterisk was entered for the mineral that was considered the 'major' or most prominent mineral in the specimen.

A few observations can be made about these cataloguing efforts. Firstly, this example illustrates how, once a cataloguing system is formed, it becomes self-reinforcing. Geoffrey C. Bowker and Susan Leigh Star call this the 'inescapable inertia of terms or categories already in use' (2000: 117). Harold Arndt decided what information from Vaux's 1925 labels was important to record in 1958. Reed replicated it in 1979, and although she expanded on it in her later Excel spreadsheet, the catalogue kept fundamentally the same form until the present nearly 70 years later. As these cataloguing systems become naturalized, the worldviews that created them fade into the background. They contribute to what Michel Foucault (1970) called *epistemes*: the background frameworks that define what counts as knowledge in a particular culture at a particular moment. The unchanged categories illustrate what Turner (2020) calls 'epistemic loyalties': a material reinforcement of worldview. Turner (2020: 26) illustrates how this material reinforcement ingrains colonial and racist ideologies in institutions: 'power [is located] in the in-between liminal spaces, in relationships, and in "mindless work"…morality is therefore not located in a particular person's or institution's ideology. Instead, it arises from everyday practices and existence' (see also Turner 2016, 2017). Across 99 years of cataloguing, each inventory that used these same categories reinforced the ideologies that produced them. The unvarying nature of these categories represents an unbroken lineage in how our culture thinks about minerals and land, extending back to the eighteenth century. This self-reinforcing organization of knowledge has implications far beyond how we catalogue minerals: it trains future generations in how to *think* about minerals. It sets the standard for what is important, and what is not. Specifically, it denies that humans and the environment are important in mineralogy. As Bryn Mawr's minerals constitute a collection used for teaching, this denial becomes part of the unspoken curriculum.

A second observation that can be made about the cataloguing history of V.4476 is that curators clearly envisioned themselves, or people like them, as the users. The fields in these catalogues are intended only for people looking for a mineral by name or locality. Later, Reed adds the possibility that a user might try to sort the catalogue to look for sets of minerals based on their crystal system, formula, or type of locality. This expands the catalogue's usability for mineralogists and curators but does not expand the audience beyond the field of geology. Nor has the historically white field of geology felt internal pressure from individuals with diverse backgrounds and experiences to change what counts as meaningful knowledge about minerals. Geology as a discipline, at least in the USA, has the lowest racial diversity of all the sciences (Dutt 2019; Bernard and Cooperdock 2018).

Thirdly, this example demonstrates how cataloguing choices can result in lost information. None of the cataloguers after 1925 thought it was important to note the year when the specimen entered the Vaux Collection, as can be seen in what was recorded on Vaux's tag. For many of the specimens in this collection the original Vaux tag is now gone; any handwritten notes on the backs of his cards are gone with them. Even when tags have been preserved, Vaux's personal knowledge has been forgotten: he presumably understood what his notations of 'R.M.' and 'bchy' meant, but we do not. That information is likely lost forever.

A fourth observation is that new information was *added* to the catalogue. Between 1925 and 2009 the specimen gained mineralogical context with the insertion of its mineral formula and system. These were not pieces of information extracted from the specimen itself (the primary source) – they were searched for in mineralogical publications (secondary sources) and attached to the specimen. In the intervening years between catalogue systems, an additional mineral name (malachite) was attached to the specimen. An interpretive judgment on the value of each specimen was also attached to the record: Reed included her assessment of whether the specimen is 'Very Good' as a display mineral.

A fifth thing to consider is that significant information is missing from all these catalogue formats. These are not just gaps in knowledge, they are gaps *in the catalogue itself*. None of these catalogues have fields, or even blank space, for more than the basic mineralogic and findplace information. These omissions have three negative effects: 1) they restrict the audience (the communities which mined this azurite had different names for the blue crystals); 2) they reinforce a value system that disconnects specimens from people and environments (this azurite is related geologically to the land it came from, biologically to the ecologies it was tied to, and historically to the people involved in its extraction); and 3) they make it more

difficult for curators to use the specimens in displays, online exhibits, or other interventions (how can we tell stories we don't know?). Each of these omissions in its own way marginalizes the human and more-than-human communities in the area where the specimen was found.

Finally, we can see in this example how such categories enforce the isolation of the specimen from its original contexts. For five years now curators at Bryn Mawr have been researching the histories of the Tsumeb Mine that yielded this specimen. This research has produced dozens of references to historical documents and archives that relate this specimen directly to the land, people, and ecologies of its origin (see Hearth 2021, Hearth 2023, and Robbins et al. 2024: 29-42). Where could these references be placed in this catalogue? Even when research is conducted to re-articulate the relationships between specimens and their human and ecologic contexts, there is nowhere to save these stories. Thus V.4476 remains disconnected from anything more than 'Name,' 'Number,' 'Locality,' and the catalogue enforces and preserves that disconnection.

## Conclusion

Minerals have unique relationships to land, ecologies, and people. They are the foundations of ecosystems and the raw materials out of which cultures and economies are hammered. They have also fuelled and funded extractive empires at the expense of human and more-than-human ecologies. Minerals are entwined in complex networks of influence: they are the literal bedrock of everything that happens across the surface of the Earth. However, mineral cataloguing practices have systematically disregarded these relationships. The mineral cataloguing standards handed down to modern curators include fields derived from the values of the European Enlightenment and Scientific Revolution. Absent are places to record the chain of humans who brought the mineral out of the ground and into the collection or to describe the environmental impact of that extraction.

It is not an accident that catalogues declare those relationships meaningless. Colonialism removes an object from an interconnected web of relationships and significance, stripping it of its unique context and assigning it 'universal' signifiers that fit a Western intellectual framework which pretends to be placeless and objective but of course cannot be. Natural historians in Europe during the eighteenth- and nineteenth-century treated the natural world as a set of discrete specimens, stripping them of their context for the scientific purpose at hand by removing them from their 'chaotic' surroundings and re-fitting them into a Western hegemonic system of nomenclature and understanding.

These cataloguing practices affect the world beyond the collection storeroom. A mineral catalogue's disregard for a specimen's human and environmental relationships reinforces how geologists think about land – as 'natural' and separate from humans (and even from environment). In the case of Bryn Mawr, a teaching college, the mineral collection carries an explicit pedagogical role, and its invisible worldviews have taught generations of geologists what *is* and *is not* important. The unspoken mandate of the mineral catalogue is that a geologist should attend to a mineral's crystal system and oxide category – not to the rates of silicosis in the labourers who opened the Earth for us to walk in. From this perspective, being geologist requires carefully seeing past any human or ecological dimensions and attending instead to the supposedly objective reality beneath.

Practically speaking, revising how we catalogue minerals is useful. It allows curators to preserve research efforts to recontextualize mineral specimens. It also facilitates the task of intervening in and interpreting specimen histories. While none of this could be described as decolonial work, restoring and preserving specimens' context is a necessary step in any future directly reparative actions. We cannot engage in decolonial work if we do not know or preserve the full histories of specimens. Beyond practical considerations though, revising mineral cataloguing practices is epistemologically necessary. The categories of empire can be turned against themselves by preserving the evidence of what they have destroyed. Even when data fields are left blank, the presence of human and ecological categories begins breaking down the long refusal of geologists to consider the impact of our practices. A student's seemingly small but consistent interactions with catalogues can become a physical practice of remembering what is meaningful.

In Part 2 (Robbins et al. 2024: 29-42), we re-envision what a mineral catalogue could

be. We examine how the categories of IMA-approved nomenclature, localities, and crystal systems could be revised to preserve the relationships that cataloguing practices historically discarded. We also confront the risks and practical limitations that a cataloguer faces when attempting to use this traditional tool of extraction instead as a tool of reconnection.

**Acknowledgments**

We are deeply grateful to the Bryn Mawr College 360° programme and its coordinator, Sarah Theobald, for all their support. The authors would also like to thank Eleanor Armstrong and Camille-Marie Sharp for organizing review sessions for this issue, and Erika Anderson, Zandra Yeaman, Elysia French, and Eugenia Kisin for their thoughtful feedback during pre-submission review sessions. We also thank three anonymous reviewers for their genuinely helpful reviews!

**Notes**

1 Yvette Cabrera, 'Nuclear Buildup Sickened His Community. Then It Caught Up with Him,' Center for Public Integrity 2022. https://publicintegrity.org/environment/nuclear-waste-navajo-nation-personal-battle-radioactive-uranium-cancer-environmental-justice/, accessed 22 January 2023.

2 Michele Lawson, 'The DRC [Democratic Republic of Congo] Mining Industry: Child Labour and Formalization of Small-Scale Mining', The Wilson Center 2021. https://www.wilsoncenter.org/blog-post/drc-mining-industry-child-labour-and-formalization-small-scale-mining , accessed 22 January 2023.

3 Rita Aspinwall, 'Fond du Lac Band Files Federal Complaint over PolyMet Mine.' Fond Du Lac Band of Lake Superior Chippewa 2019. https://www.fdlrez.com/downloads/PR/FDLFederalComplaintOverPolyMet_20190912.pdf, accessed 11 January 2023.

4 Gustave Lester and Tamara Pico, 'The Colonial History of Geology in the United States, Part One.' Insurrect! 2022. https://www.insurrecthistory.com/archives/2021/11/12/the-colonial-history-of-geology-in-the-united-states, accessed 10 October 2022.

Gustave Lester and Tamara Pico, 'The Colonial History of Geology in the United States, Part Two'. Insurrect! 2022. united-states-part-two, accessed 10 October 2022.

5 Decolonize This Place (n.d.). https://decolonizethisplace.org/, accessed 12 October 2022.

6 Beyond Extraction, 'Mining at the Museum: A Counter-Tour', Beyond Extraction 2020. https://www.beyondextraction.ca/, accessed 10 October 2021.

7 The George Vaux, Jr. mineral collection is distinct from, though related to, the William S. Vaux Mineral Collection housed at the Philadelphia Academy of Natural Sciences, inasmuch as William was George Vaux Jr.'s uncle.

**References**

Adler, M. (2016) 'The Case for Taxonomic Reparations', *Knowledge Organization*, 43 630-40

Alberti, S. (2005) 'Objects and the Museum,' *Isis*, 96 (4) 559-71.

Ashby, J. and Machin, R. (2021) 'Legacies of colonial violence in natural history collections', *Journal of Natural Science Collections,* 8: 44-54.

Ashcroft, B., Griffiths, G. and Tiffin, H. (2002) *The Empire Writes Back: Theory and Practice in Post-Colonial Literatures*, London: Routledge.

Autry, L.T.S. and Murawski, M. (2019) 'Museums Are Not Neutral: We Are Stronger Together', *Panorama: Journal of the Association of Historians of American Art*, 5 (2)

https://doi.org/10.24926/24716839.2277.

Azoulay, A.A. (2019*) Potential History: Unlearning Imperialism*, London: Verso.

Barringer, T. and Flynn, T. (1998) *Colonialism and the Object: Empire, Material Culture, and the Museum,* London: Routledge.

Barringer, T. (1998) 'The South Kensington Museum and the Colonial Project', in Tim Barringer and Tom Flynn (eds) *Colonialism and the Object: Empire, Material Culture, and the Museum,* 11-28, London: Routledge.

Bernard, R. and Cooperdock, E. (2018) 'No Progress on Diversity in 40 Years', *Nature Geoscience,* 11 292-95.

Borucki, A., Eltis, D. and Wheat, D. (2015) 'Atlantic History and the Slave Trade to Spanish America', *The American Historical Revie*w, 120 (2) 433-61.

Bowker, G.C. and Star, S L. (2000) *Sorting Things Out: Classification and its Consequences*, Cambridge, MA: The MIT Press.

Brockway, L.H. (1979) *Science and Colonial Expansion: The Role of the British Royal Botanic Gardens,* New York: Academic Press.

Brunton, C., Howard C., Cooper, J.A. and Besterman, T. P. (1984) *Guidelines for the Curation of Geological Materials,* London*:* Geological Society.

Carter, D. J. and Walker, A.K. (1999) 'Documentation', in David J. Carter and Annette K. Walker (ed), *Appendix I: Care and Conservation of Natural History Collections*, 193-7, Oxford: Butterworth Heinemann.

Cato, P.S. (1994) 'Guidelines for the Care of Natural History Collections', *Collection Forum* 10 (1) 32-40.

Chakrabarty, D. (2008) *Provincializing Europe: Postcolonial thought and historical difference*, Princeton, NJ: Princeton University Press.

Chakrabarti, P. (2019) Gondwana and the politics of deep past. *Past & Present*, 242 (1) 119-53.

Cleevely, R.J. (1986) 'Old Labels are Old Hat!?', *Geological Curator,* 4 (8) 483-6.

Conn, S. (1998) *Museums and American Intellectual Life, 1876-1926,* Chicago: University of Chicago Press.

Cooper, J.A., Phillips, P.A., K.W. Sedman and Stanley M.F. (1980) *Geological Record Centre Handbook*, Duxford: Museum Documentation Association.

Das, S. and Lowe, M. (2018) 'Nature Read in Black and White: decolonial approaches to interpreting natural history collections,' *Journal of Natural Science Collections,* 6 4-14.

de Sousa Santos, B. (2015) *Epistemologies of the South: Justice against epistemicide*. London: Routledge.

Dutt, K. (2019) 'Race & Racism in Geosciences,' *Nature,* 13 2-3.

Edwards, E. and Mead, M. (2015) 'Absent Histories and Absent Images: Photographs, Museums and the Colonial Past', *Museum and Society,* 11 (1) 19-38.

Fegadel, A.R., 2023. Uranium mining, environmental inequality, and Native American health. In Michael A. Long, Michael J. Lynch and Paul B. Stretesky (eds) *Handbook on*

*Inequality and the Environment*, 556-73, Cheltenham: Edward Elgar Publishing.

Fitzgerald, G.R. (1988) 'Documentation guidelines for the preparation and conservation of paleontological and geological specimens,' *Collection Forum,* 4 38-45.

Foucault, M. (1970) *The Order of Things,* London: Tavistock.

Garba, T. and Sorentino, S.M. (2020) Slavery is a metaphor: A critical commentary on Eve Tuck and K. Wayne Yang's "decolonization is not a metaphor", *Antipode* 52 (3) 764-82.

Garneau, D. (2016) 'Imaginary Spaces of Conciliation and Reconciliation: Art, Curation, and Healing' in Dylan Robinson and Keavy Martin (eds) *Arts of Engagement: Taking Aesthetic Action in and Beyond the Truth and Reconciliation Commission of Canada*, 21-41, Waterloo: Wilfred Laurier University Press.

Gelsthorpe, D. (2021) 'Decolonising Manchester Museum's Mineral Collection – A Call to Action', *Journal of Natural Science Collections,* 9 12-28.

Grimme, G. (2020) 'Systemizing Provenance Research on Objects from Colonial Contexts,' *Museum and Society*, 18 (1) 52-65.

Hauskeller, C., Artinian, T., Fiske, A., Schwarz Marin, E., González Romero, O.S., Luna, L.E., Crickmore, J. and Sjöstedt-Hughes, P. (2023) Decolonization is a metaphor towards a different ethic. The case from psychedelic studies, *Interdisciplinary Science Reviews,* 48 (5) 732-51.

Hearth, S. (2021) The "World's Greatest Mineral Locality": Haillom, Ndonga, Herero, and the Early Colonial Histories of Tsumeb, Namibia, *Earth Sciences History,* 40 (2) 433-60.

Hearth, S. (2023) Geologists as Colonial Scouts: The Rogers Expedition to Otavi and Tsumeb, Namibia, 1892–1895, *Earth Sciences History*, 42 (2) 385-415.

Hearth, S. and Robbins, C. (2022) 'Mineral Displays as Embodiments of Geologic Thought and Colonial Invisibility', *Journal of Natural Science Collections,* 10 3-17.

Holmes, A. (1911) 'The Association of Lead with Uranium in Rock-minerals, and its Application to the Measurement of Geological Time', *Proceedings of the Royal Society (A),* 85 248-56.

Knell, S. (2000) *The Culture of English Geology, 1815-1851: A Science Revealed Through its Collecting*, Aldershot: Ashgate.

Liboiron, M. (2021a) *Pollution is Colonialism*, Durham, NC: Duke University Press.

Liboiron, M. (2021b) 'Decolonizing Geoscience Requires More than Equity and Inclusion'. *Nature Geosciences* 14 876-7.

Impey, O. and MacGregor, A. (2000) *The Origins of Museums: The Cabinet of Curiosities in Sixteenth and Seventeenth Century Europe*, London: British Museum.

McOuat, G. (2001) 'Cataloguing Power: Delineating "Competent Naturalists" and the Meaning of Species in the British Museum', *British Journal for the History of Science,* 34 1-28.

Molina, N., Hosang, D.M. and Gutierrez, R.A. (2019) *Relational Formations of Race: Theory, Method, and Practice*, Berkeley: University of California Press.

Phillips, L. (2022) 'An Incomplete Glossary of Change to Activate Decolonising and Indigenising Practices in Museums', *Museum International*, 74 (3-4) 118-33.

Pratt, M.L. (1992) *Imperial Eyes: Travel Writing and Transculturation*, London: Routledge.

Price, D. (1986) 'Documentation after "The Guidelines"', *Geological Curator,* 4 (8) 481-3.

Raji, D. M., Williams, D. R., Lawrence, D. A., Evans, D. N., Burnard, P. T., Kumar, D. M. S., Mills, K., Rogers, S., Souch, C., Jameson, G., Houghton, J. and Dowey, N. (2023) 'Changing the Narrative: the Hidden Histories of British Colonial Mineral Exploitation in Africa', *EGU General Assembly 2023, Vienna, Austria*, 24–28 Apr 2023, EGU23-15959.

Reséndez, A. (2017) *The Other Slavery: The Uncovered Story of Indian Enslavement in America*, Boston: Mariner Books.

Robbins, C., Hearth S., Weldon, M., Anderson, A., Bieber-Stanley, R., Chernila, A., Christ, H., Cosgrove, H., Hanson-Rosenberg, M., Hill, C., Hofstetter, M., Lazo, E., Ludlow, I., Lyster, S., Myers, R., Nash, J., Reed, G. and Saint-Amour, J. (2024) 'Cataloguing Minerals, part 2: Re-imagining Mineral Catalogue Description To Address Colonial Legacies,' *Museum & Society*, 22 (3) 29-42.

Roberts, D.A. and Jones, M.D. (1975) 'Instructions for Use of Mineral Specimen and Geology Specimen Record Cards', *Newsletter of the Geological Curators Group,* 3 141-6.

Roberts, D.A. (1986) 'Towards a Common Strategy for Geological Documentation: The MDA view', *Geological Curator,* 4 (8) 477-80.

Schiebinger, L. and Swan, C. (2007) *Colonial Botany: Science, Commerce, and Politics in the Early Modern World*, Philadelphia:⁋University of Pennsylvania Press.

Scott, M. (2007) *Rethinking Evolution in the Museum: Envisioning African Origins*, London: Routledge.

Simpson, M.G. (1996) *Making Representations: Museums in the Post-Colonial Era,* London: Routledge. https://doi.org/10.4324/9780203713884.

Spivak, G.C. (1988) 'Can the Subaltern Speak?' in Cary Nelson and Lawrence Grossberg (eds) *Marxism and the Interpretation of Culture*, 271-313, Basingstoke: Macmillan.

Tuck, E. and Yang, K.W. (2012) 'Decolonization is not a Metaphor', *Decolonization: Indigeneity, Education & Society,* 1 (1) 1-40.

Turner, H. (2016) 'Critical Histories of Museum Catalogues', *Museum Anthropology,* 39 102-10 doi:10.1111/muan.12118.

Turner, H. (2017) 'Organizing Knowledge in Museums: A Review of Concepts and Concerns', *Knowledge Organisation,* 44 (7) 472-84.

Turner, H. (2020) *Cataloguing Culture: Legacies of Colonialism in Museum Documentation,* Vancouver:⁋University of British Columbia Press.

Vogel, J. (2015) 'Mineral Collections as Markers of Social, Cultural and Political Spaces in the Eighteenth and Early Nineteenth Century', *Historical Social Research / Historische Sozialforschung,* 40 (1) 301-20.

Yusoff, K. (2019) *A Billion Black Anthropocenes or None*, Minneapolis:University of Minnesota Press

Zografos, C. (2022) 'The Contradictions of Green New Deals: Green Sacrifice and Colonialism', *Soundings,* 80 (14) 37-50.