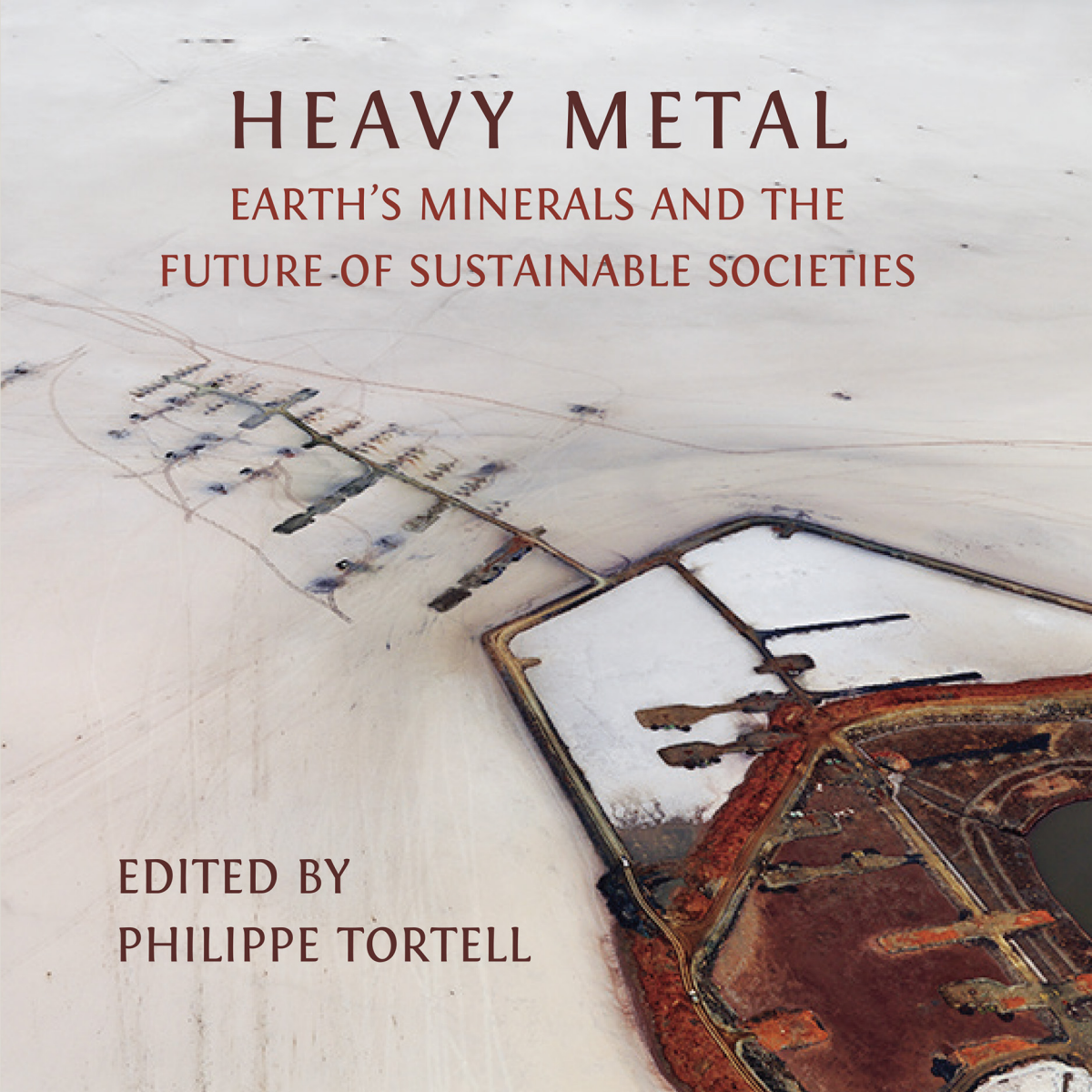
HEAVY METAL

EARTH'S MINERALS AND THE FUTURE OF SUSTAINABLE SOCIETIES



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A Lithium Fascination

Christopher Sainsbury

These days, cell phones are perhaps the most ubiquitous expression of our portable digital age. The rechargeable batteries in these devices contain about two grams of lithium, creating a very personal and immediate connection to this element, which I wanted to reflect in my musical composition. Along with their instruments, the members of the brass quintet are asked to use their phones at various parts of the movement. This is meant to signify our fascination with (and perhaps addiction to) lithium, an element which has enabled new means of communication, work, mobility and entertainment.

I also wanted to reflect the place-based nature of lithium production in Australia, the country where I work and live, and where my ancestors, the Dharug (Eora) Aboriginal people, have lived for thousands of years in the mountain and coastal regions surrounding Sydney. The Mount Cattlin Mine in Western Australia contains an estimated twelve million metric tons of lithium ore, in a hard rock deposit that must be excavated, crushed and processed. The mine contains an estimated 150,000 metric tons of lithium oxide (Li_2O), which can be extracted to yield around 60,000 metric tons of metallic lithium; enough to produce batteries for about one million Tesla Model S electric vehicles, or about thirty billion cell phones.

The Mount Cattlin Mine is located near 33° South and 120° East, situated on the traditional lands of Aboriginal people to my west. I used these geographic coordinates to anchor the musical tones of my composition.

The notes of a C major scale are:

C – D – E – F – G – A – B – (C)

1 – 2 – 3 – 4 – 5 – 6 – 7 – (8)

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Here, the note B is scale tone 7, yet B is also inherently below the first C (1), and I took the liberty of designating it as zero (0). Mapping these geographic coordinates against the C major scale results in the following notes:

33 (EE) and 120 (CDB)

This mapping of geography into music gives us the mine's coordinates in the pitches of C major. In a happy coincidence, these pitches align nicely with those used in Augusta Read Thomas's *conductivity* motif (1, 2, 3 and a flattened 7), which was written to tie the individual movements together.

To give the music more complexity and nuance, I represented E (latitude) and CDB (longitude) with a set of pitches drawn from a bi-tone series (F F# G A B C# E G C F#). This formed one melodic theme (a pitch hub) within the piece. The use of the bi-tone series makes up much of the lithium movement, and is something of a signature sound in many of my works. One can simply listen for the emergent soundscape without having to understand the theory behind it. The sounds are like blocks of color, whose juxtaposition and progression within the composition moves between directed action, repose and mystery.

Comparing the bi-tone series against the chromatic scale, we see that four tones are excluded, A♭, B♭, D and E♭. I use these 'leftover' notes as a second pitch hub, constituting a sub-section of the movement that represents the hidden and forgotten 'labor' of the mining sector. My use of two distinct pitch hubs in the composition can also be taken to represent different societal attitudes towards lithium mining, while also reflecting my own mixed European and Indigenous heritage.

My musical representation of the Mount Cattlin Mine is inherently nuanced and abstract. I did not attempt to capture a sonic signature of the mine. Rather, I wanted to signal my knowledge of the mine (and others like it in Australia), while also exploring how modern colonial societies use lithium, and extract it from the lands of Aboriginal people. The form of the work arches between dawn and dusk, with a performance note to the musicians of first dust stirring as they begin to play,

and dust settling at the end of the piece. The geographic coordinates are represented throughout, and there is a theme exploring labor, and a chorale for reflection. Near the end, some notes are interrupted, like the intermittent reception of a cell phone. The final chord is restful, yet also has an element of the unresolved, for there is lots yet to discuss and negotiate. Through this composition, I hope to articulate our complex relationship with lithium and the digital technologies it enables, while inspiring a less-Eurocentric approach to envisioning a sustainable future.

Silicon

Chris Chafe

After oxygen, silicon is the second most abundant element on Earth. The Planet's crust is rich in silicate minerals, like quartz, which contain atoms of silicon and oxygen bonded together in crystals. By comparison, the pure elemental form of silicon is much rarer in nature. The super-flat, shiny and exceedingly pure silicon wafers used for electronic components are only a recent human invention. They are produced by refining silica sand into pure blocks of silicon, which are sliced into sheets about the thickness of a human fingernail. Over the past half century, these thin silicon wafers and their embedded circuits have provided a literal backbone for the growth of digital technologies around the globe.

The semi-conducting properties of silicon have made it an essential building block for ever denser electronic circuits, which switch current on and off at extremely high speeds. The three-year-old laptop on which I composed the silicon movement of the *Heavy Metal Suite* contains several billion transistors. Today, a processor chip in a new laptop has twenty billion or more transistors, approaching the number of neurons in the human brain (about one hundred billion). Although a transistor isn't a neuron, the scale of the circuitry that can be built with silicon is nonetheless remarkable. Equally

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