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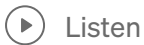
“Faulty” GPUs, gold, forks, cooking pots or iron-rods: Recycling computers in Accra, Ghana

Cyrus Khalatbari

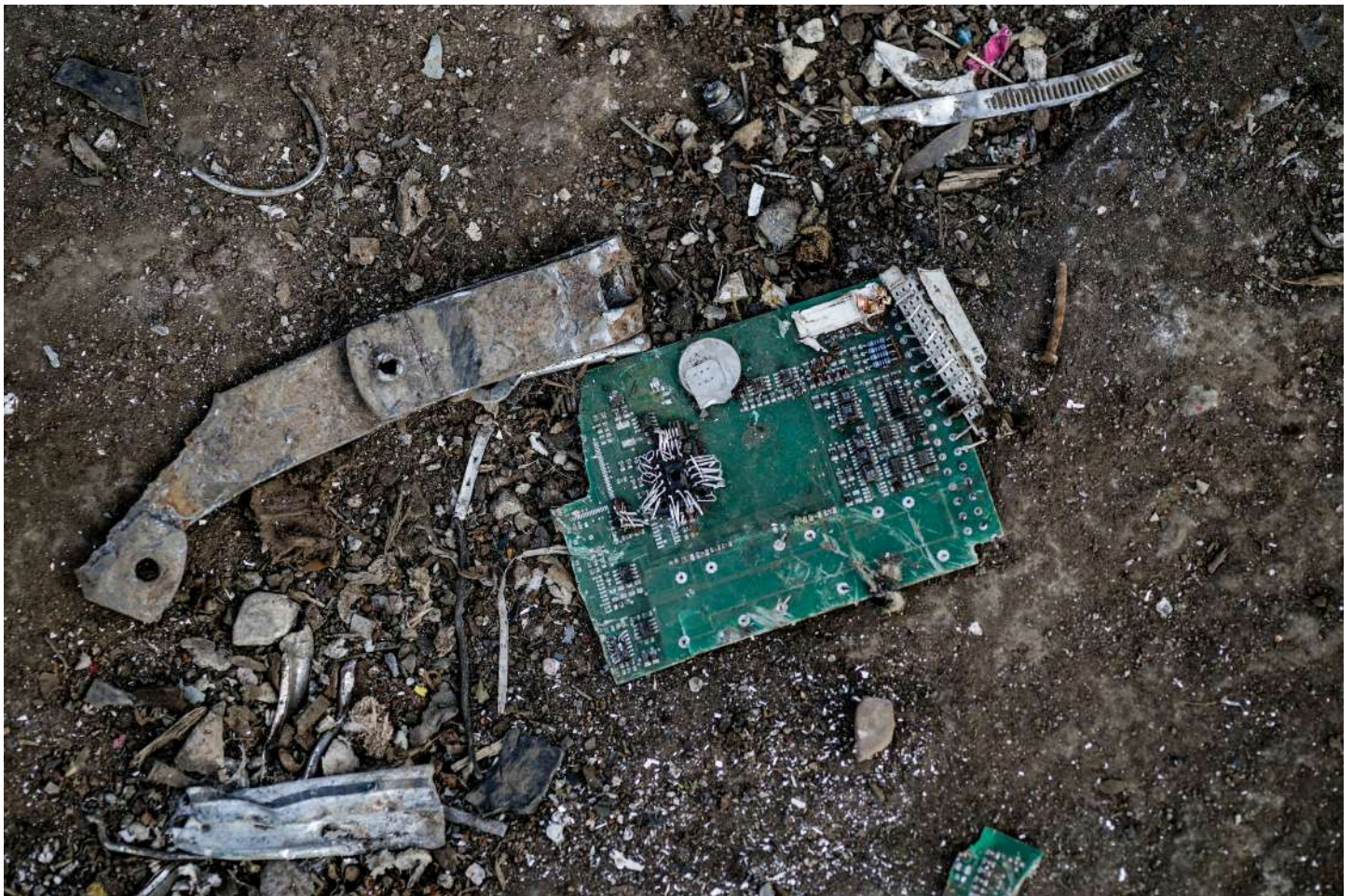


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*During the autumn of 2023, FIBER hosted Part 5 of its **Reassemble Lab: Practising Permacomputing**, a concept and a nascent community of practice oriented around issues of resilience and regenerativity in computer and network technology that is derived, among others, from permaculture principles. In his second contribution, **Cyrus Khalatbari** delves into the circular economies and e-waste repair and recycling culture of Ghana, contextualising these practices within permacomputing.*



E-waste. Photo by [Hans Ripa](#) on [Unsplash](#)

Introduction

In addition to the plethora of minimalistic interfaces that embody cloud aesthetics and seamless processes, computers are becoming increasingly more streamlined and compact. The design of laptops, with motherboards, keyboards, mice and screens embedded in the same object and optimised for efficiency and convenience, is handy to manipulate and use for the variety of tasks our day to day lives require. By encapsulating, however, all these components in a smooth and minimal case, a specific socio-technical gesture is operated: a gesture of oversimplification and obfuscation (of computing) into something weightless and opaque to our senses. What is moreover hidden behind this streamlined and seamless design [1] is the lifecycle of these objects. It is, in other words, the material, environmental, and human labour infrastructure of extraction, optimisation, and recycling/waste our computational culture heavily depends upon.

This article gravitates toward the same research object as [my piece on liquid nitrogen \(ln2\) overclockers](#): the graphical processing unit (GPU). As the hardware component unlocking computing power needed to sustain our maximalistic processes, the GPU is inherently linked to the permacomputing approach and its

care for the chips principle. In both articles, I expose how our computer processes — outside of the western dominant discourses around computing as immaterial, weightless, and seamless — are materially and environmentally situated. While liquid nitrogen overclockers are, however, praised and celebrated by our sociotechnical cultures, the community I disentangle here is rendered invisible by tropes around electronic “waste” oversimplifying the idea of a process that is simply being “dumped” to the Global South.

These tropes are also reinforced by the logic of planned-obsolescence and the capitalistic pressure to “trash” our devices: due to both marketing campaigns showcasing brand new products and the exponential difficulty to repair and maintain these objects. Positioning myself in opposition to these tropes, my contribution spotlights these processes at play when computers are discarded.

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practices and challenges while receiving computers that are always more compact, streamlined, and blackboxed. [2] The second section centres on labour infrastructures at play when extracting the chip’s valuable metals. In the third section, I introduce the reader to circular economies of casting and smelting used to produce new objects from computer *scraps*. Finally, in the conclusion, I contextualise these within [the first workshop of FIBER’s Reassemble Lab 5: Practising Permacomputing](#), which took place in Amsterdam, on October 13 and 14, 2023.



Fig. 1. Temma Harbour. Credit: Wikimedia.

“Through time, machines are lighter and smaller”: Issues with compact GPUs

Imported by *burgers* [3] from North-America and Europe [4], second-hand computers arrive in Ghana by shipments and containers through the local harbour of Temma (fig. 1). With the majority of computers discarded by our western and European countries at the end of their two-years lifespan, these are bought for very minimal prices through auctions. They come from institutions and companies renewing their stocks: hospitals, schools, universities, and others. Because they are bought in bulk, they arrive in Ghana untested. Collected by local shop owners, they rely on the labour infrastructure of repairers and technicians maintaining and preparing them for the local market. In order to optimise shipments and gain space both during transportation and resell (fig. 2), *burgers* often prioritise laptop computers. Following a repairer and vendor nicknamed X I met at Circle (Accra), this preference is also driven by customers’ desires to acquire computers that are

“always lighter, smaller, and more compact”. Due to the lack of instructions, repairing these computers is however exponentially challenging.

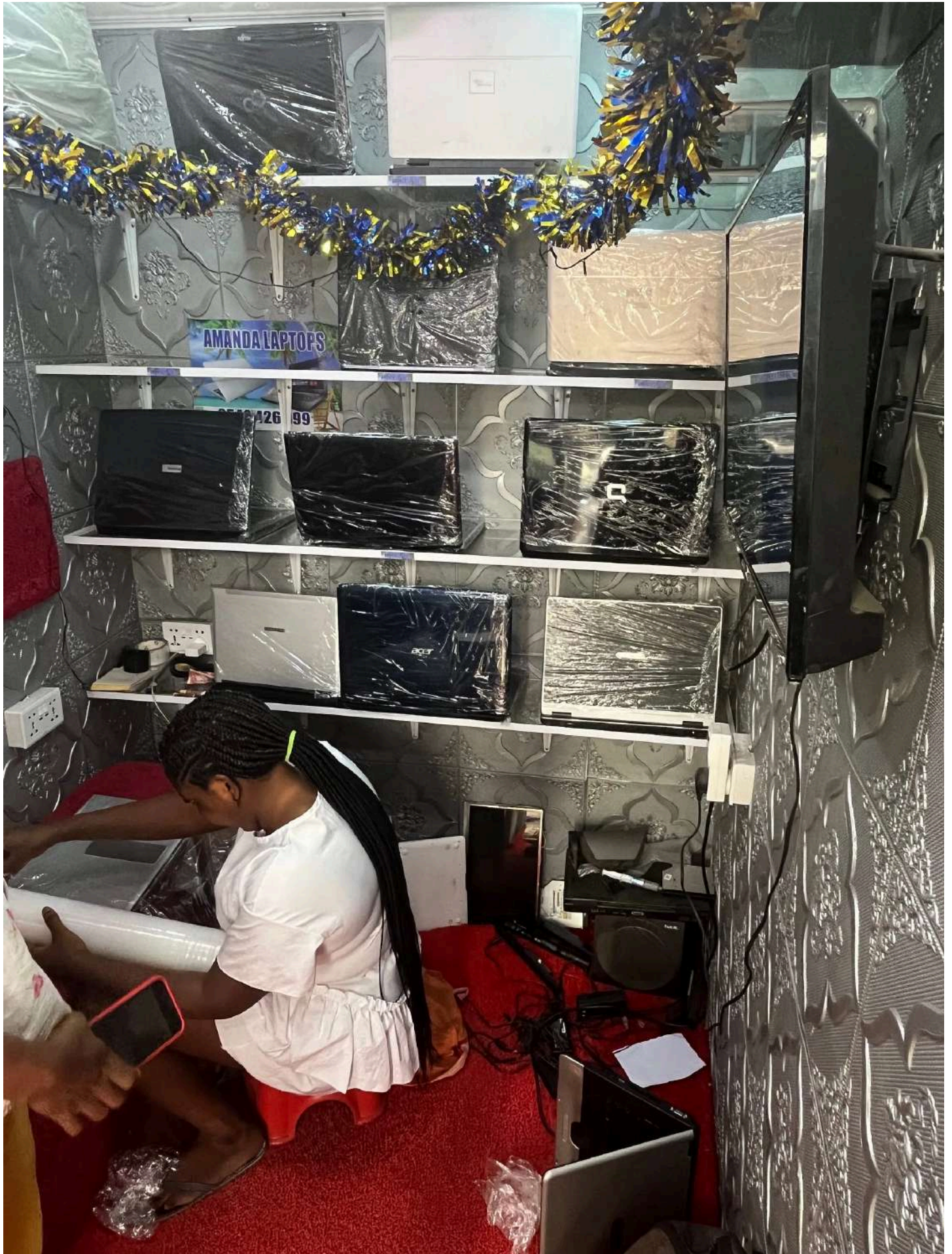


Fig. 2. Personal Computers (PCs) on display, Computer shop. Circle, Accra. Image courtesy of the author.

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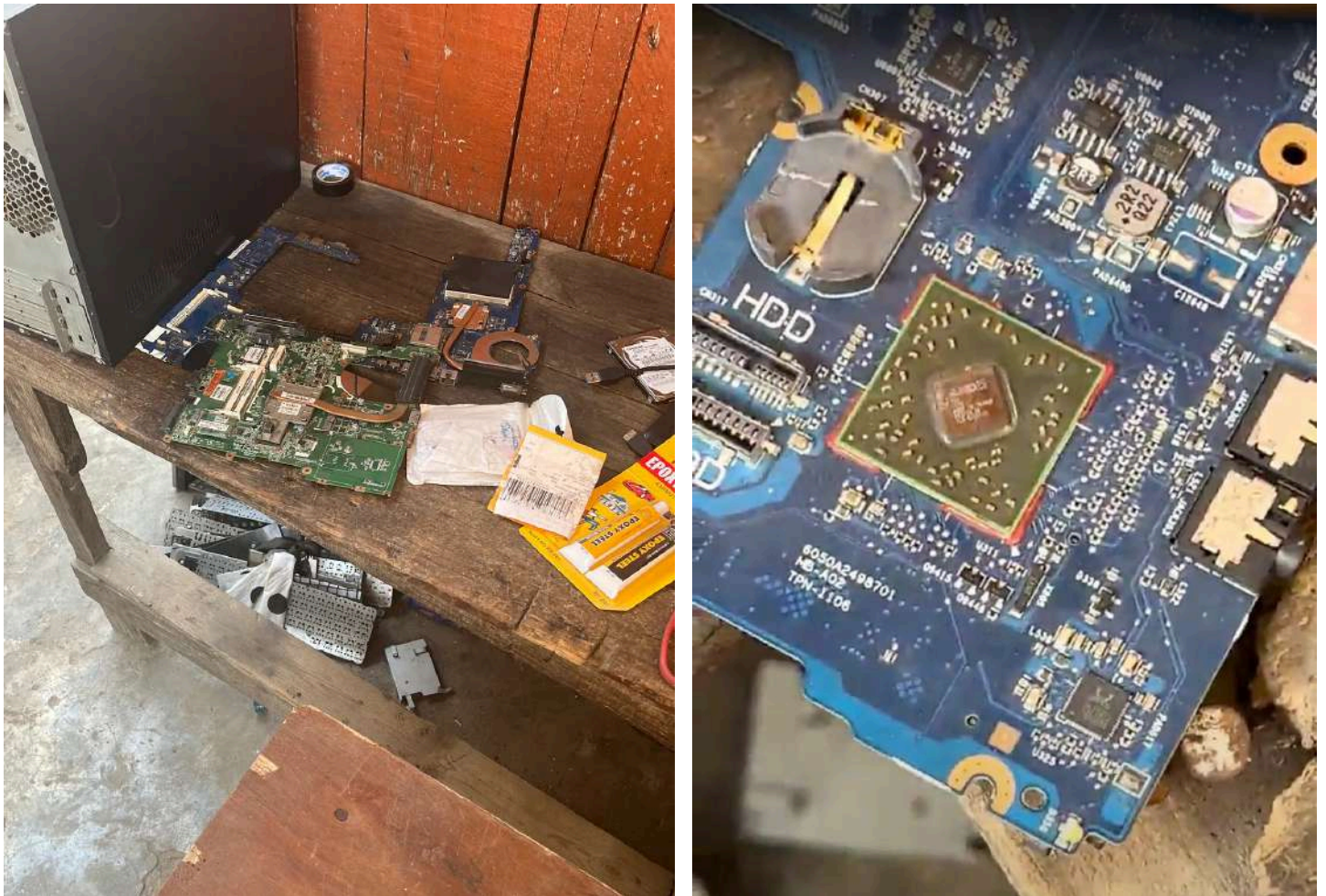


Fig. 3. Motherboards and onboard GPUs being repaired. Repairer workshop. La Paz, Accra. Images courtesy of the author.

In addition to the fact some of these computers initially arrive incomplete or drilled for privacy reasons [5], this difficulty comes from the disruption occurring in tools these repairers have access to. Following X, this is directly correlated to the streamlined nature of the produced PCs; the more shrunk and embedded their components are on the motherboard, the more difficult they are to maintain. When working with *faulty* GPUs for example (fig. 3), this compactness prevents them from using multimeters they have access to: often too imprecise for probing the chip's integrated-circuits (ICs) or electric currents. This disruption also occurs at the level

of soldering irons and heat guns that, in the words of X, are not efficient enough to remove these chips without “messing up with the rest of the board”.



Fig. 4. Electric cables sorted to extract copper. Credit: AMP.

“We call them original boards”: extracting gold in condemned GPUs

When a *faulty* GPU [6] cannot be repaired, the full motherboard it is on becomes *condemned* [7]. Stated by X, it then enters into the realm of scrap-dealers and dismantlers, who tour the city in order to acquire these discarded digitals for a few Ghanaian *cedis* [8], before scavenging them for valuable metals. While their *burger* and repairer colleagues are making better profits from more compact and lighter computers, the rule followed by these scavengers is the opposite: the heavier these hardwares are, the more copper, aluminium, steel or brass they can provide (fig. 4). Argued by a scrap-dealer and dismantler nicknamed Z I met at Agbogbloshie (Accra), these chips and motherboards are also praised for another type of metal. This metal is gold: sold at 64,732 USD a kilogram on the global market.



Fig. 5. Original boards sorted. Credit: AMP.

Following the words of Z, this creates a new typology in the way these objects are framed: referred to *original* boards (fig. 5) if they contain the precious metal. Extracting gold is also a technically challenging process that cannot be done on site, because of the disruption repairers face in regards to the tools they have access to. Around Agbogbloshie where Z and other dismantlers are based, this reality creates emerging labour dynamics: with the presence of Chinese workers collecting these *condemned* motherboards via Nigerian middle-men. As argued by the scrap dealer and dismantler, these boards are then shipped to mainland China through the local harbour of Tema, where they become embedded in a broader planetary circuit of recycling.



Fig. 7. Aluminium sand casting method. Credit: AMP.

Aluminium casting and steel smelting: The circular economy of GPUs in Ghana

Before Chinese workers interact with these *original* boards, three metals are mainly scavenged from these objects: copper, aluminium, and steel. Extracted with different techniques involving the use of fire, screw-drivers, chisels or hammers, these metals activate different circuits of transformation that are both local and planetary. These circuits are structured around a specific characteristic: each metal's melting temperature. Whether from aluminium found in the GPU's heatsink (fig. 6) or steel located on the frame, their processing involves different needs and requirements. Aluminium, for example, melts at the relatively low temperature of 660 °C. With a homemade charcoal furnace connected to an oxygen tank [9], craftsmen are able to engage with the melting technique of “sand casting” (fig. 7): pouring the liquified metal made on a sand mould that can easily be reconfigured to create patterns and shapes.



Fig. 8. Indian-owned steel smelting factory. Images courtesy of the author.

Produced objects then vary from cooking pots to plates, forks, knives or spoons and are sold in local markets across Accra. With a melting temperature ranging between 1,205 °C to 1,370 °C, steel, however, relies on a different economy. This one gravitates around a few Indian-owned smelting factories (fig. 8) that specialise in the mass production of iron rods used in the construction industry. Confirmed by M in charge of daily productions of one of these firms, the scarce expertise they offer in melting the metal is then a major advantage for making business with scrap-dealers and recyclers.

With trucks coming “as far as Togo, Benin, Nigeria, Ivory-Coast and even Mali”, the company secures at a competitive price high quality steel that, once transformed into rods, is then shipped internationally. Such as Chinese workers managing the extraction and recycling of the gold in trashed printed-circuit-boards (PCBs), this presence of indian-owned factories contributes to further sheds light on systemic inequalities inside Africa and Ghana. It makes tangible, in other words, how local workers depend on foreigners operating in Ghana in order to keep sustaining their labour and extract profit from objects trashed from the west.

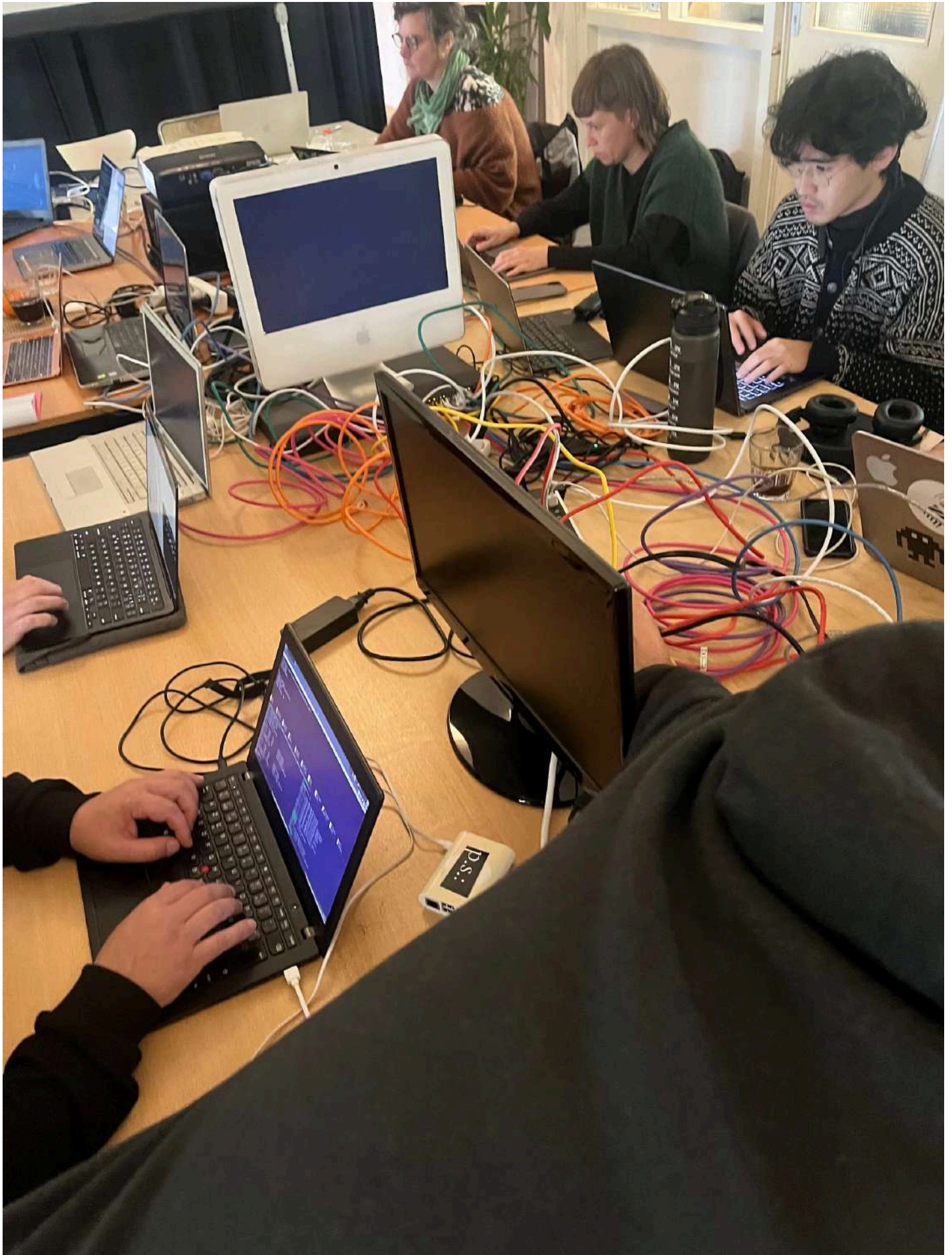


Fig. 9. First workshop on permacomputing, Fiber. Image courtesy of the author.

Conclusion: from electronic “waste” to inter-manipulable assemblages of technology inside the Permacomputing framework

During FIBER’s workshop, we were asked to bring our old and discarded computers. On the working table structuring the space and our collective inquiries, hosts Aymeric (Mansoux) and Lukas (Engelhardt) gathered all sorts of electronics ready to be opened, dismantled and reconfigured (**fig. 9**). These hardwares, first intended to be trashed, were given a second life: turned into notepads, web radios or local servers acting as alternatives to cloud services. Although we operated from a privileged position rooted in our occidental countries, our explorations echoed the work and practices of Ghanaian recyclers. In dialogue with their infrastructures of labour and knowledge, our workshop aimed moreover to further shed light and support one of the core characteristics of permacomputing: its *care for the chips* principle.

With the underlying issue that these hardwares cannot be recycled easily and depends, as made explicit by emerging labour dynamics around gold extraction in Agbogbloshie (Accra), on costly and energy-extensive processes, we focused on maximising their lifespans. This was for example done by reinstalling minimal operating systems (OS) on these machines, or using them for localised processes and in a materially-situated way. Outside of the dominant model of technology structured around planned obsolescence and the culturally-situated meaning of electronic “waste”, this enabled us to collectively reframe our computational processes in a more sustainable way. Borrowing from Osseo-Asare and Abbas, it allowed us to better understand the material layer of our computing culture as “inter-manipulable assemblages” [10] that can be transformed, recycled, and reappropriated.

Notes

[1] Matt Ratto. 2007. Ethics of Seamless Infrastructures: Resources and Future Directions. *The International Review of Information Ethics* 8, 20–27.

<https://doi.org/10.29173/irie93>

[2] Bruno Latour. 1999. *Pandora’s Hope: Essays on the Reality of Science Studies*. Harvard University Press.

[3] The term *burger* is a Ghanaian slang referring to one of Europe’s cities where they are the most present and settled through the past fifty years, Hamburg.

[5] A recurrent case of this is the one of the hard drive, often arriving in Ghana drilled to avoid identity and data theft as well as the ability to retrace the machine's original owner.

[6] A *faulty* component refers, in Ghanaian slang, to electronic devices and circuits that do not operate properly due to short circuits and other anomalies.

[7] Still in Ghanaian slang, *condemned* is used in the context of computers that are too faulty to be fixed.

[8] The *cedi* is the currency of Ghana.

[9] Emily Lynn Osborn. 2009. "Casting aluminium cooking pots: labour, migration and artisan production in West Africa's informal sector, 1945–2005." *African Identities*, 7(3), 373–386, <https://doi.org/10.1080/14725840903031858>

[10] D.K. Osseo-Asare & Yasmine Abbas. (2015). "Investigating 3E-materials at Agbogbloshie in Accra, Ghana." *Proceedings of the Engineering4Society 2015 Conference*, 41–50. <https://doi.org/10.1109/Engineering4Society.2015.7177898>

Cyrus Khalatbari is an artist, designer and PhD candidate of the joint program between the Geneva Arts and Design University (HEAD – Genève, HES-SO) and the Swiss Federal Institute of Technology (EPFL). Cyrus makes websites, sculptural works, and publishes on computing cultures, critical technical practices and research-creation.



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