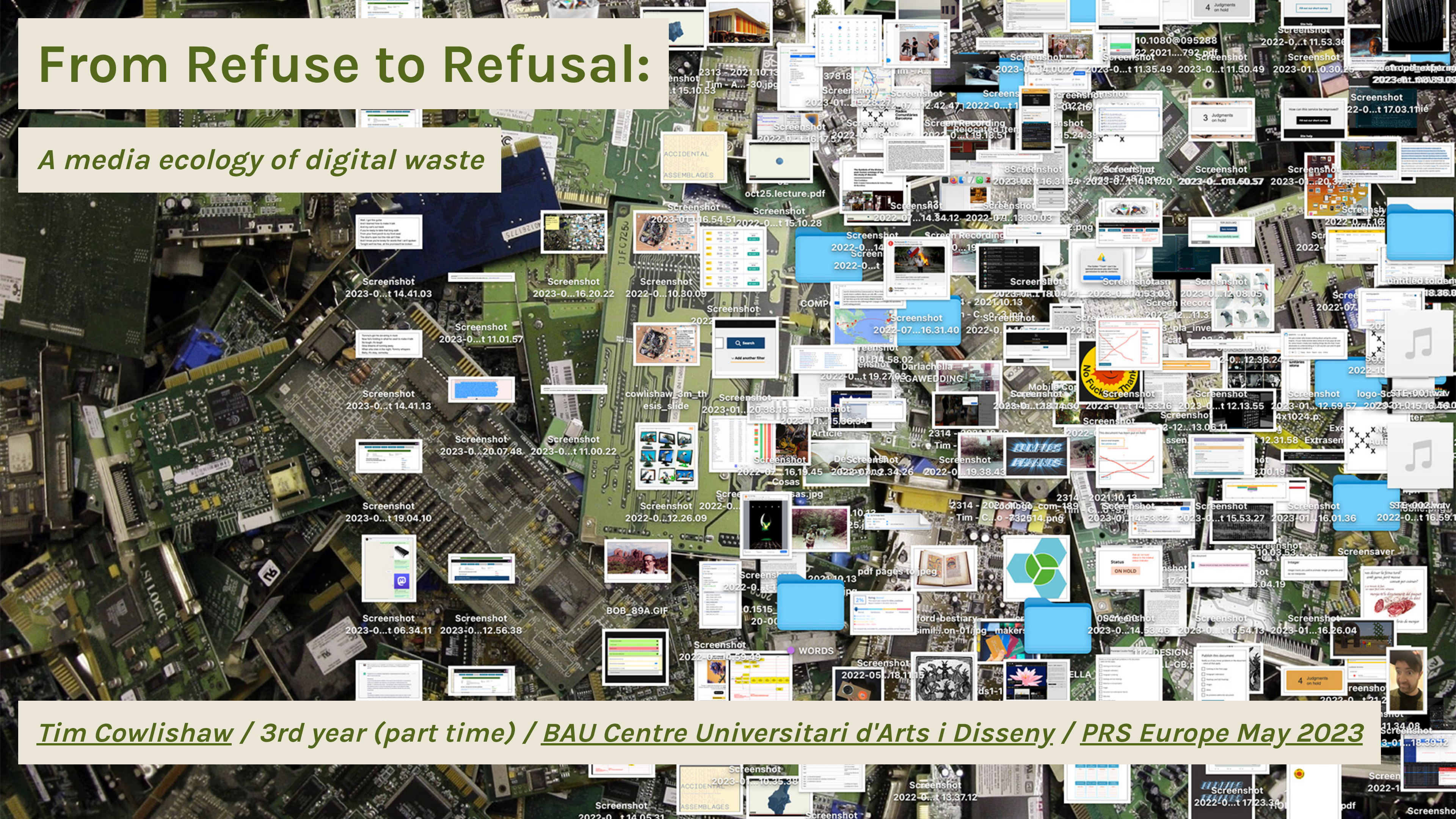


Royal Holloway Materialities of Media

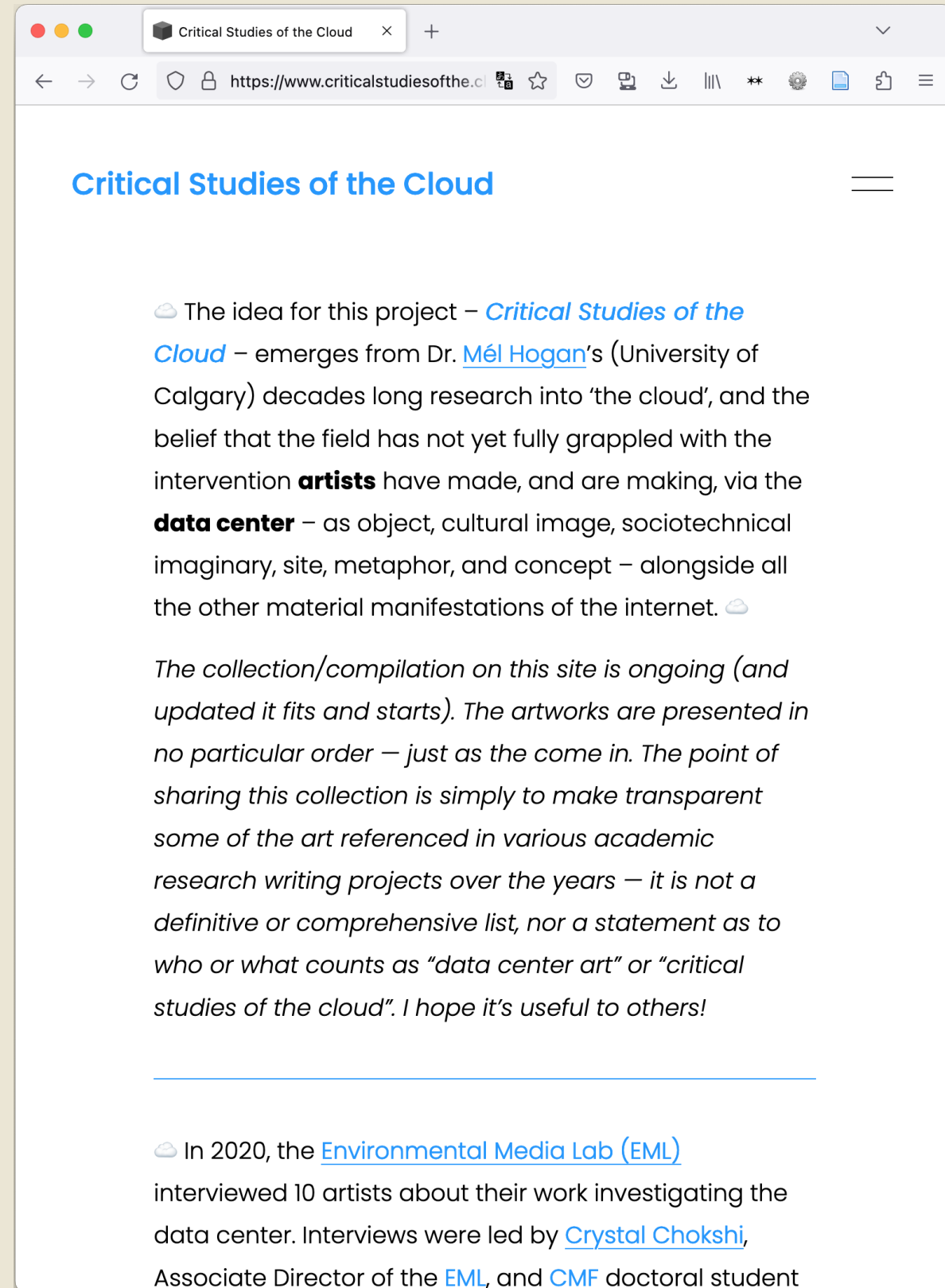
From Refuse to Refusal:

A media ecology of digital waste

Tim Cowlshaw / 3rd year (part time) / BAU Centre Universitari d'Arts i Disseny / PRS Europe May 2023



"The Cloud" and the environment

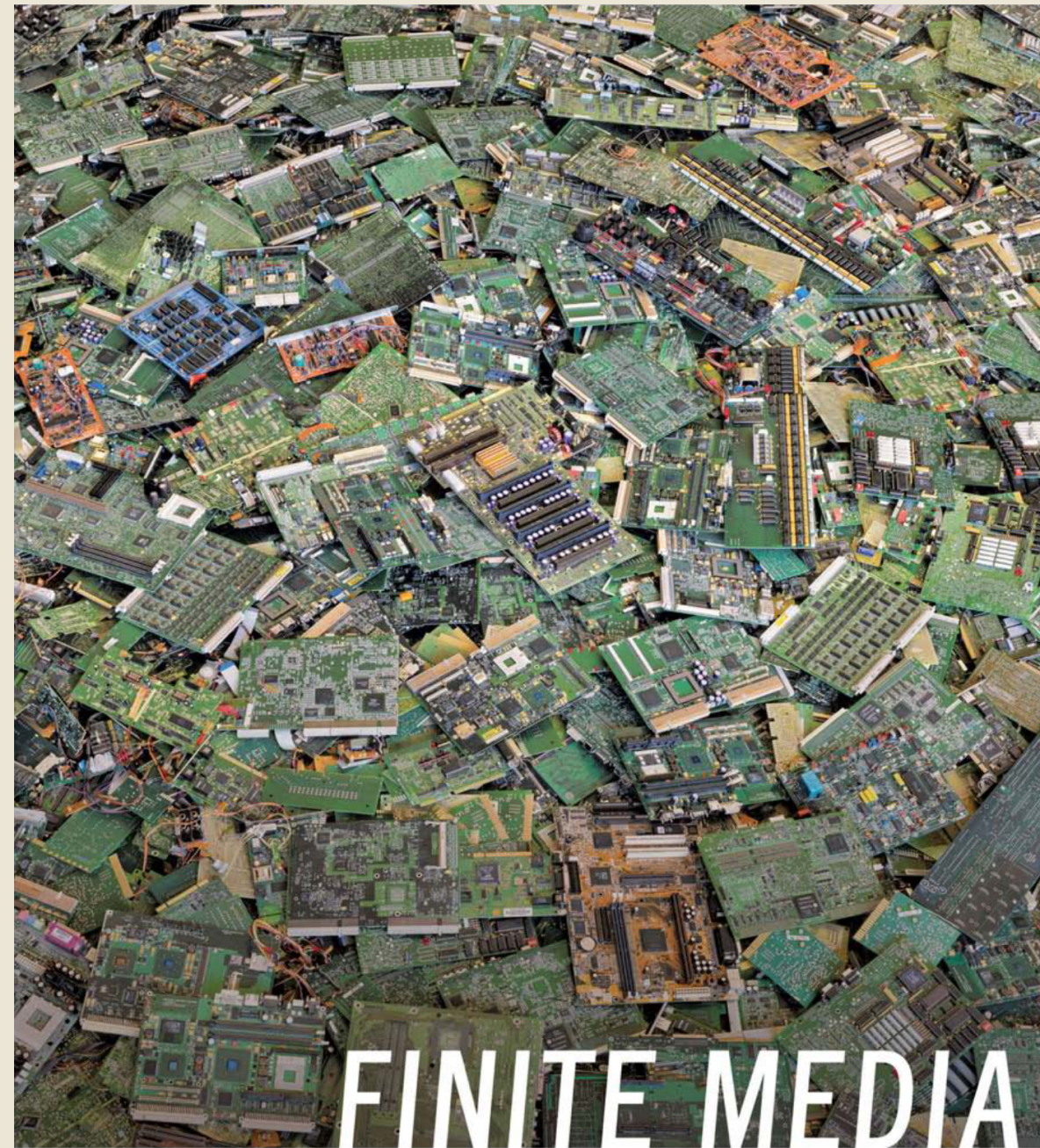


Critical Studies of the Cloud

The idea for this project – *Critical Studies of the Cloud* – emerges from Dr. [Mél Hogan](#)'s (University of Calgary) decades long research into 'the cloud', and the belief that the field has not yet fully grappled with the intervention **artists** have made, and are making, via the **data center** – as object, cultural image, sociotechnical imaginary, site, metaphor, and concept – alongside all the other material manifestations of the internet.

The collection/compilation on this site is ongoing (and updated it fits and starts). The artworks are presented in no particular order – just as they come in. The point of sharing this collection is simply to make transparent some of the art referenced in various academic research writing projects over the years – it is not a definitive or comprehensive list, nor a statement as to who or what counts as "data center art" or "critical studies of the cloud". I hope it's useful to others!

In 2020, the [Environmental Media Lab \(EML\)](#) interviewed 10 artists about their work investigating the data center. Interviews were led by [Crystal Chokshi](#), Associate Director of the [EML](#), and [CMF](#) doctoral student



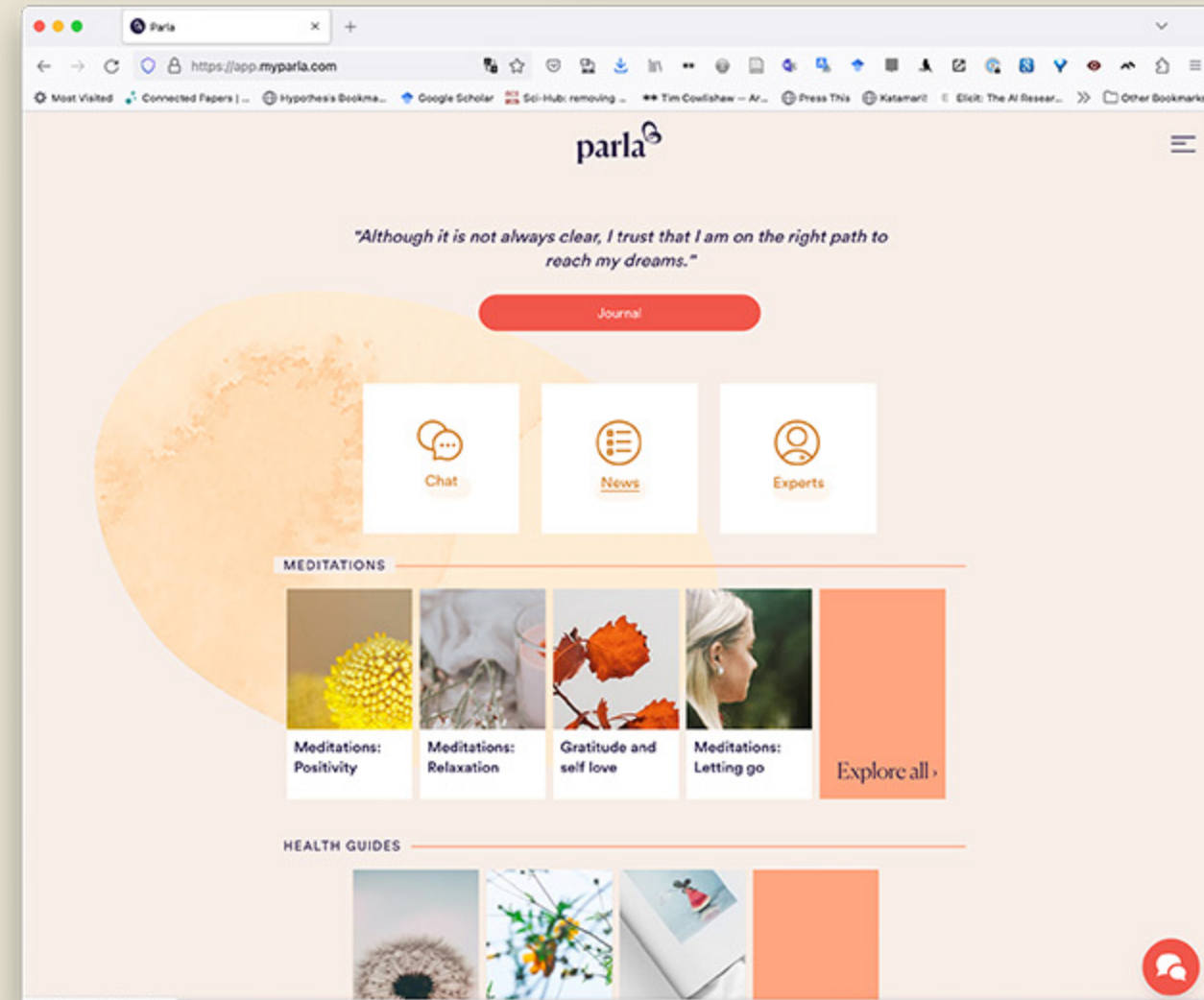
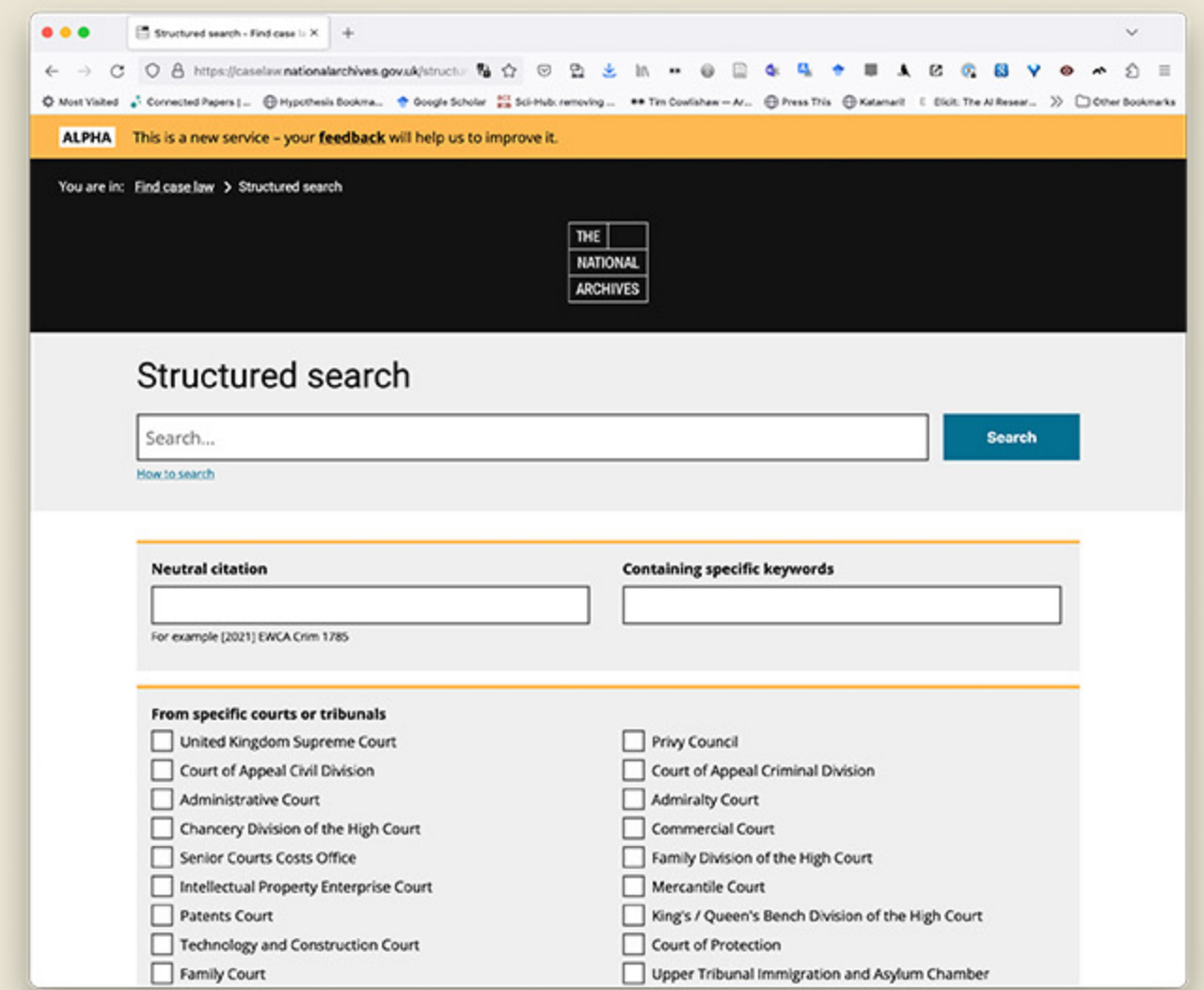
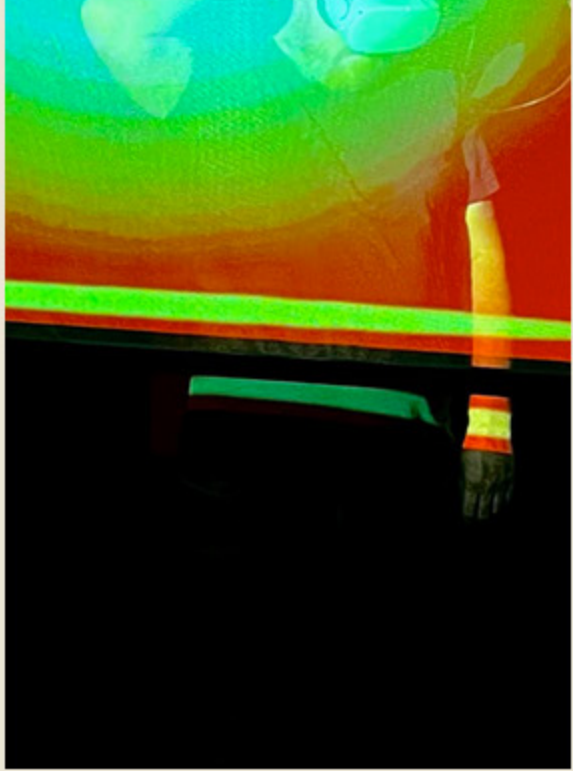
FINITE MEDIA
ENVIRONMENTAL IMPLICATIONS
OF DIGITAL TECHNOLOGIES
SEAN CUBITT



Research Questions:

- On what material resources (be it energy, physical materials, or labour) does the accumulation of digital waste depend?
- What part does my practice as both an interaction designer and computer user play in contributing to the material impact of digital media?
- **(Can this impact be mitigated through my research, and reflective practice?)**

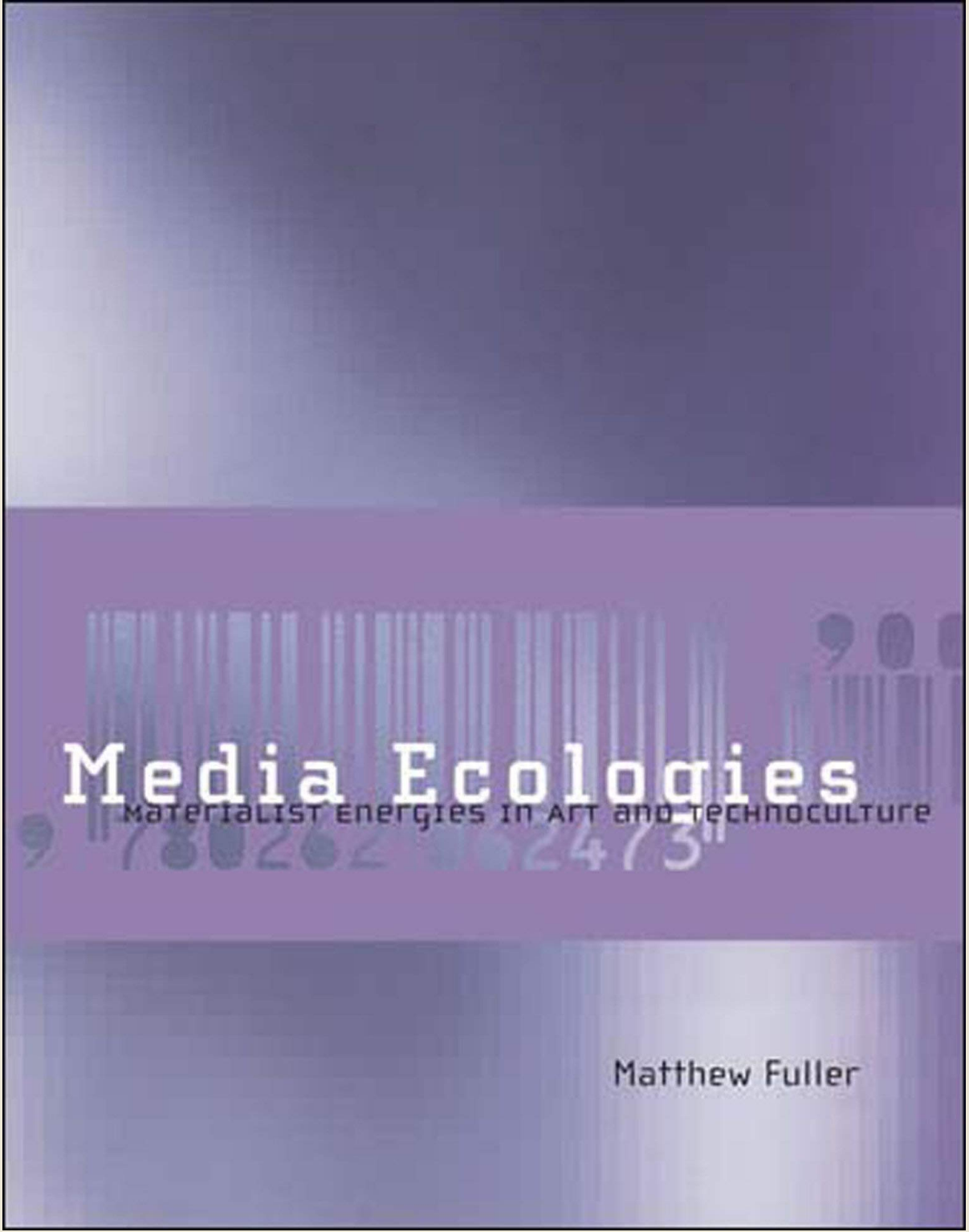
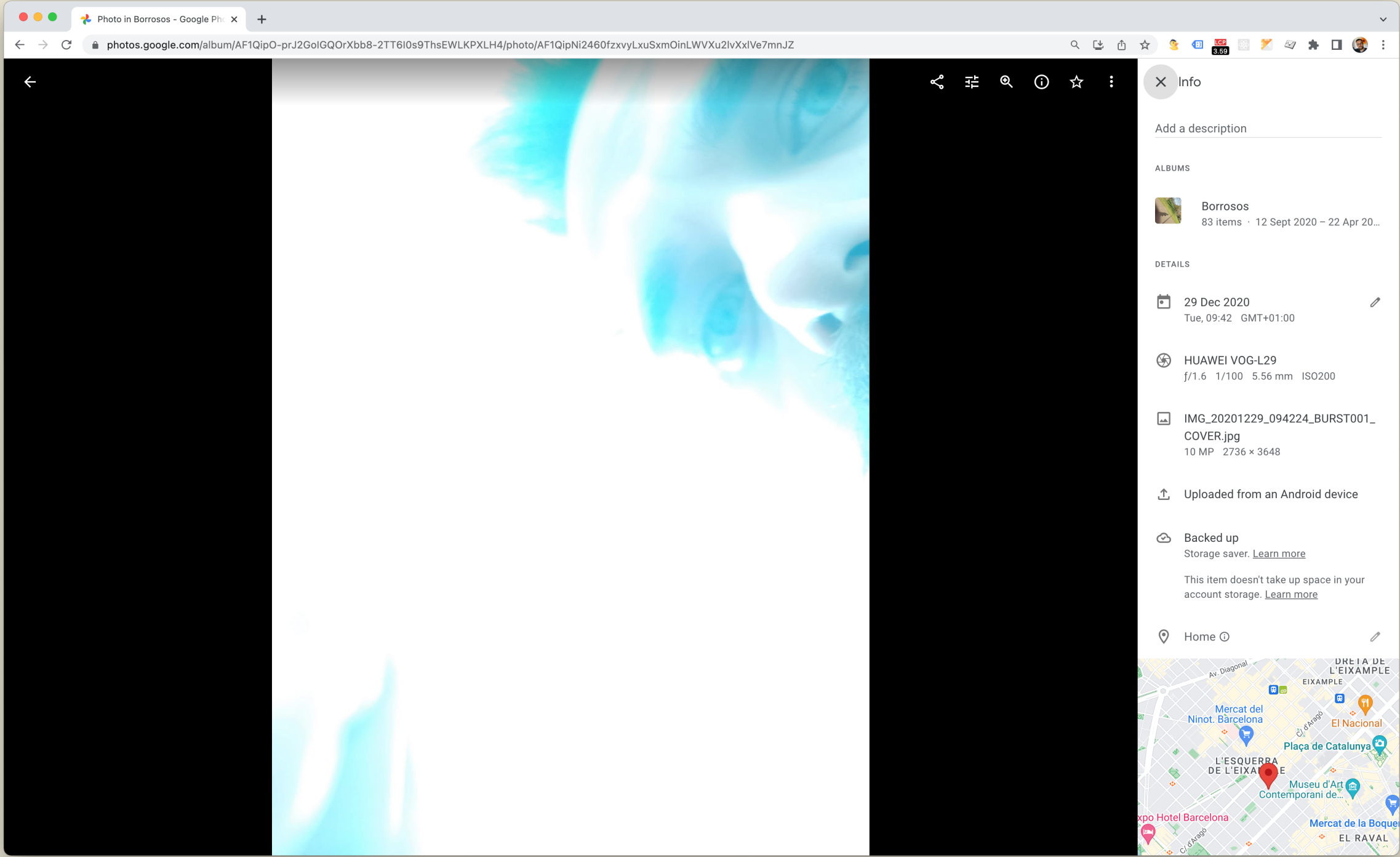
My 'practice':



Outline:

- Experiment 1: What is a JPG made of?
- Experiment 2: Compression vs Corruption
- Experiment 3: Writing a thesis, materially

What is a JPG made of?



What is a JPG made of?

- Where is this image?
- How much space does it use up?
- What does it rely on for its continued existence?

What is a JPG made of?

```
om/line/142.250.200.129
-bash: http://ip-api.com/line/142.250.200.129: No such file or
directory
[09:32:25] [tim@Tims-MacBook-Pro /Users/tim] $ curl http://ip-
api.com/line/142.250.200.129
success
Spain
ES
MD
Madrid
Madrid
28001
40.4168
-3.70379
Europe/Madrid
Google LLC
Google LLC
AS15169 Google LLC
142.250.200.129
[09:32:32] [tim@Tims-MacBook-Pro /Users/tim] $ host lh3.google
usercontent.com
lh3.googleusercontent.com is an alias for googlehosted.l.googl
eusercontent.com.
googlehosted.l.googleusercontent.com has address 142.250.200.1
29
googlehosted.l.googleusercontent.com has IPv6 address 2a00:145
0:4003:80f::2001
[09:32:42] [tim@Tims-MacBook-Pro /Users/tim] $ curl http://ip-
api.com/line/142.250.200.129
success
Spain
ES
MD
Madrid
Madrid
28001
40.4168
-3.70379
Europe/Madrid
Google LLC
Google LLC
AS15169 Google LLC
142.250.200.129
[09:32:45] [tim@Tims-MacBook-Pro /Users/tim] $
```

(0) tim@Tims-MacBook-Pro.local< 5:thesis- 6:web 7:bash*09:38

Overview **Reviews** About

in situ lo bien que están resueltos los aspectos de seguridad, alimentación eléctrica y climatización.

[See translation](#)

Like Share

Ziyang Zhang
Local Guide · 42 reviews
★★★★★ 6 years ago
A huge building in the wilderness, the pipeline behind the facade is impressive! Different temperament

Translated by Google · [See original \(Chinese\)](#)

Like Share

Julio Bleda López
Local Guide · 229 reviews
★★★★★ 5 years ago
Brutal. Las medidas de seguridad, la ubicación de los equipos, todo es una auténtica barbaridad. Es sin duda el mejor centro de datos de España.

[See translation](#)

Like Share

Sergio Cavero
Local Guide · 59 reviews
★★★★★ 5 years ago
Esta muy gui, fui a hacer una visita con la universidad, pero como es todo super confidencial, me limitaré a decir que el guía que tuvimos era muy simpático. [More](#)

[See translation](#)

IT ROOM

15,000M2

0:00 / 5:57

Telefónica inaugura 'Alcalá Data Center'

Telefónica 34.3K subscribers

146 likes

35K views · 10 years ago

La operadora inaugura su mayor centro de datos que albergará los servicios digitales más avanzados. Alcalá Data Center será un referente internacional en tamaño, seguridad y eficiencia energética. Show more

2 Comments · Sort by

Av. Punto Com

Layers

Imagery ©2023 Maxar Technologies, Map data ©2023

Google Cloud

Contact Us

Specification	EA-STORAGE-10	EA-GPU-T4
Processor	16 core CPU, 64GB RAM	NVIDIA T4 GPU, 16 core CPU, 64GB RAM
Storage	8x 2TB SSDs. Usable storage is 7.2 TB using RAID10.	4x 2TB SSDs. Usable storage is 3.6 TB using RAID10.

Economía > Tecnología

Así es el primer Data Center de Google en España

La multinacional tecnológica invierte 600 millones en el despliegue de unos servicios que, prevé, puede tener un impacto de 1.200 millones en la economía española

WATER CHANGES EVERYTHING. learn how at charitywater.org

Este miércoles, Google ha inaugurado en Madrid su nueva nube regional para el sur de Europa, unos servicios con los que busca mejorar la conectividad, almacenamiento y gestión de datos de las empresas nacionales.

2 minutos

Carles Planas Bou

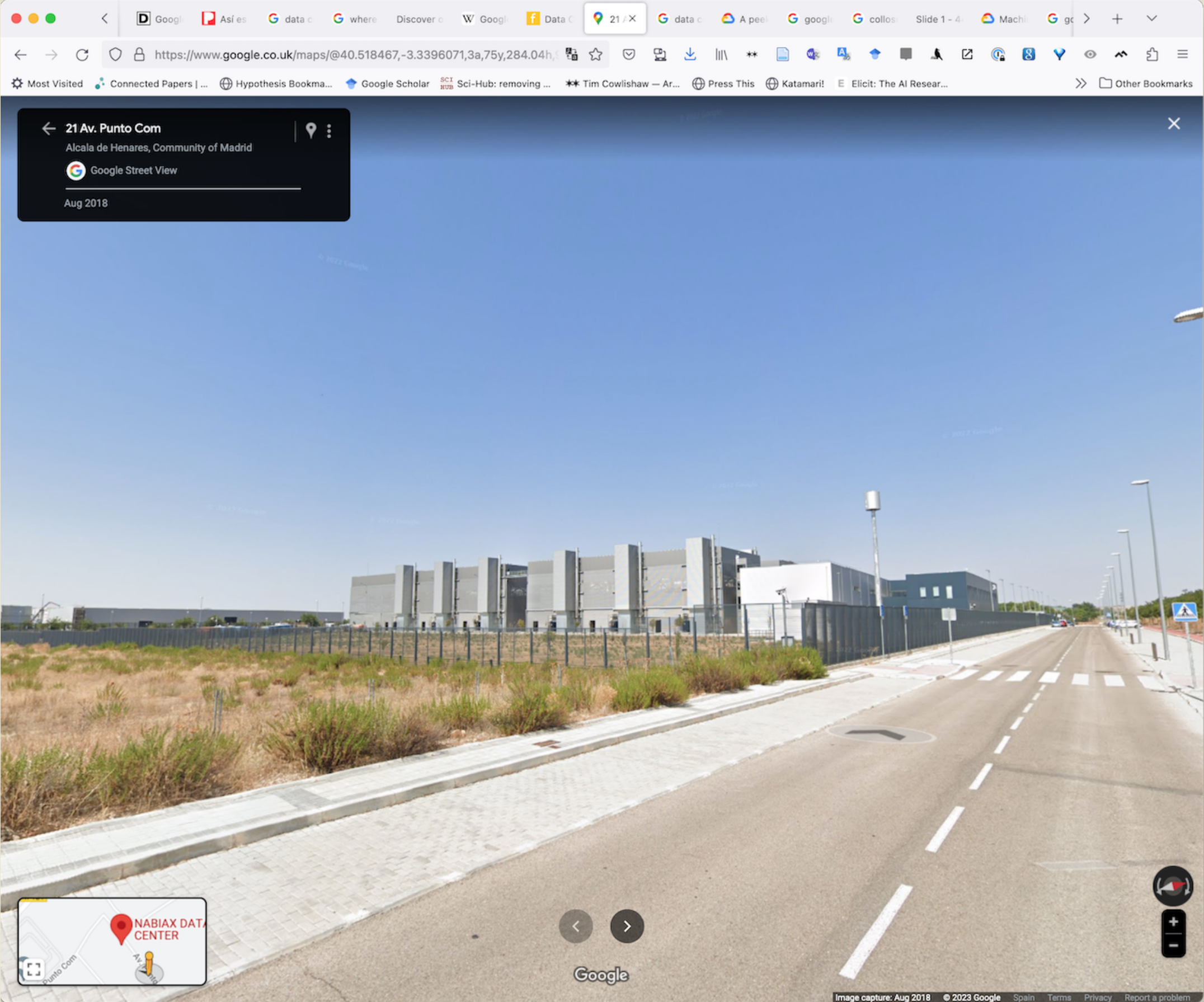
Por qué confiar

Madrid

Google

Send feedback 20 m

Infrastructures, inside and outside



Infrastructures, inside and outside

The screenshot shows a Google Maps interface. The search bar contains "nabix data centre alcalá de henares". The map displays an aerial view of a large industrial or data center complex. A sidebar on the left shows the "Reviews" tab for the location. A review by Salva Martínez, a Local Guide with 183 reviews, is visible. The review is dated "a year ago" and contains a detailed critique of the facility's operations and management. The review text is as follows:

★★★★★ a year ago

Llevo trabajando con ellos 7 años y no puedo estar más descontento con ellos. Por un lado su constante intento de borrar la palabra Telefónica en el edificio. Tengo dudas de que cumplan el Tier IV como tal, los protocolos son muy lentos, la eficacia de entrada paupérrima, la facilidad de poner consignas nula, posibilidad de comer durilla y si te lo traen búscalo tú sin posibilidad de gestionar bien el tiempo durante la crisis que tengas. A nivel técnico un mes para que pasen cableado entre armarios, 1 mes de provisionado y etiquetados de componentes incorrectos, ágiles no son. Todo subcontratado, (los chicos de seguridad amables y correctos, xo algunos técnicos de servicio poco cualificados y/o desganados (no todos y algunos muy buenos). Una vez dentro, irse es complicado si tienes servicios 24/7, pero poco a poco se consigue. Cada vez hay más racks vacíos... El centro como tal de instalaciones está bien, xo si gestión da mucho que desear...

See translation

1 Like Share

César Serrano 6 reviews


At the bottom of the map, there is a scale bar showing 20 meters and copyright information: "Imagery ©2023 Maxar Technologies, Map data ©2023 Spain 3D Earth view is not available Terms Privacy Send feedback 20 m".

Infrastructures, inside and outside

“Today, we’re excited to announce that our new Google Cloud region in Madrid is officially open,” the company announced this week. “Designed to help meet the growing technology needs of Spanish businesses, the new Madrid region (europa-southwest1) provides low-latency, highly available cloud services with high international security and data protection standards — all on the cleanest cloud in the industry.”

The new region was first announced in [June 2020](#) and is delivered in partnership with Telefónica.


Google said the Madrid region is launching with three cloud zones to prevent service interruptions, and its standard set of products, including Compute Engine, Google Kubernetes Engine, Cloud Storage, Persistent Disk, CloudSQL, and Cloud Identity.



This is the company’s first region in Spain. Google currently has nine cloud regions across Europe, with more due to launch in Turin and Berlin in the future. The Grace Hopper subsea cable landed in September 2021 in Bilbao, connecting Spain and the UK with the United States.

This is the second GCP region to open this week, after Google launched a new location in [Columbus, Ohio](#).

It’s not clear exactly what facilities Google’s new Madrid region is located in, but Telefónica operates the [Tier IV Alcalá CDG facility](#) on the outskirts of Madrid; the facility was built in 2013 and spans 23 data halls, each measuring 681 sqm, and [offers up to 100MW of capacity](#).



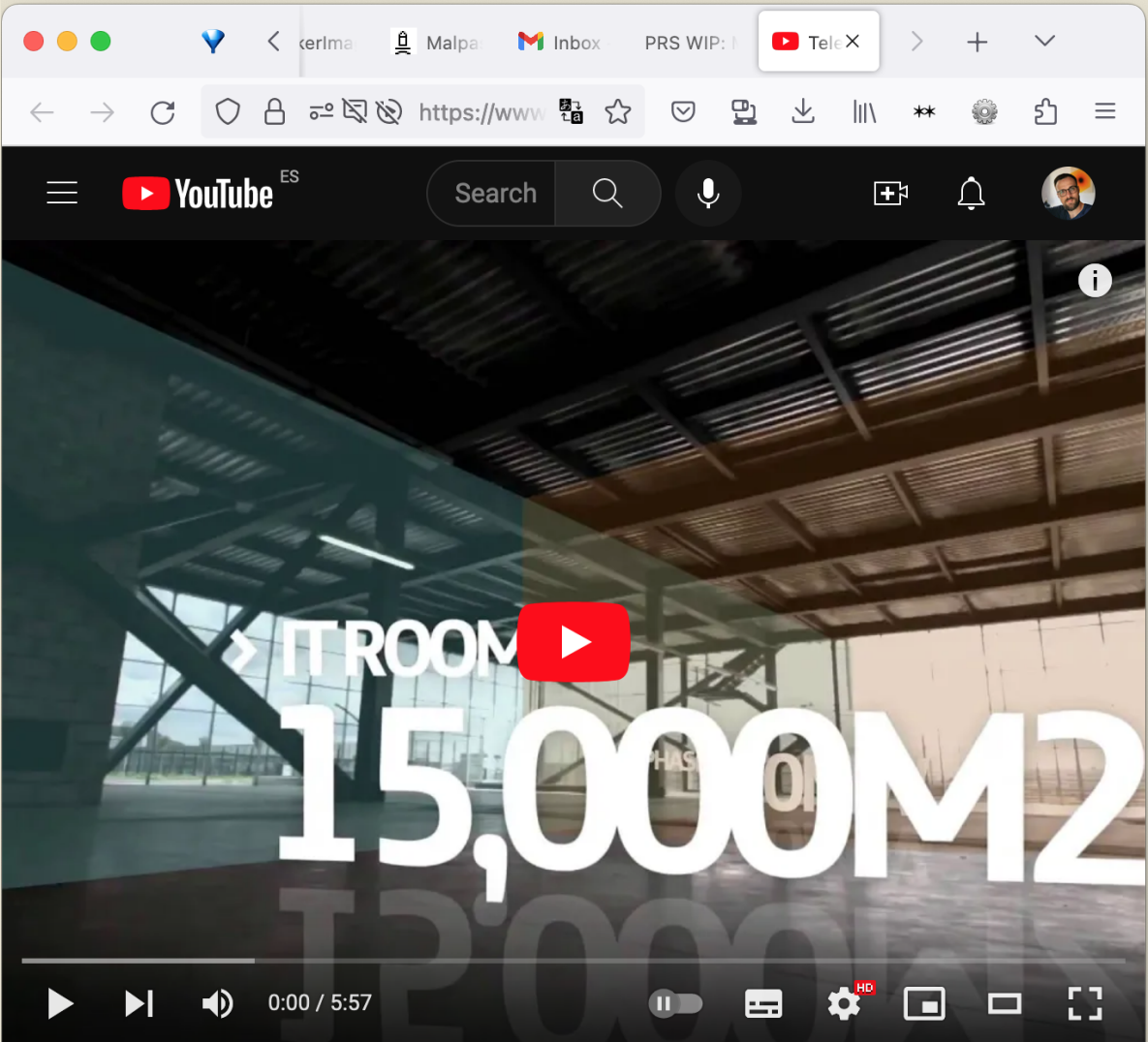
In 2020 Microsoft announced plans for a Spanish Azure region in Madrid in partnership with Telefónica, but hasn’t shared a go-live date. Oracle has also [previously partnered](#) with the telco to host an upcoming cloud region in Madrid due to go live this year.

AWS is due to launch a Spanish region [in Aragon](#) in mid-2022.

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Got it!




IT ROOM
15,000M2

Telefónica inaugura 'Alcalá Data Center'

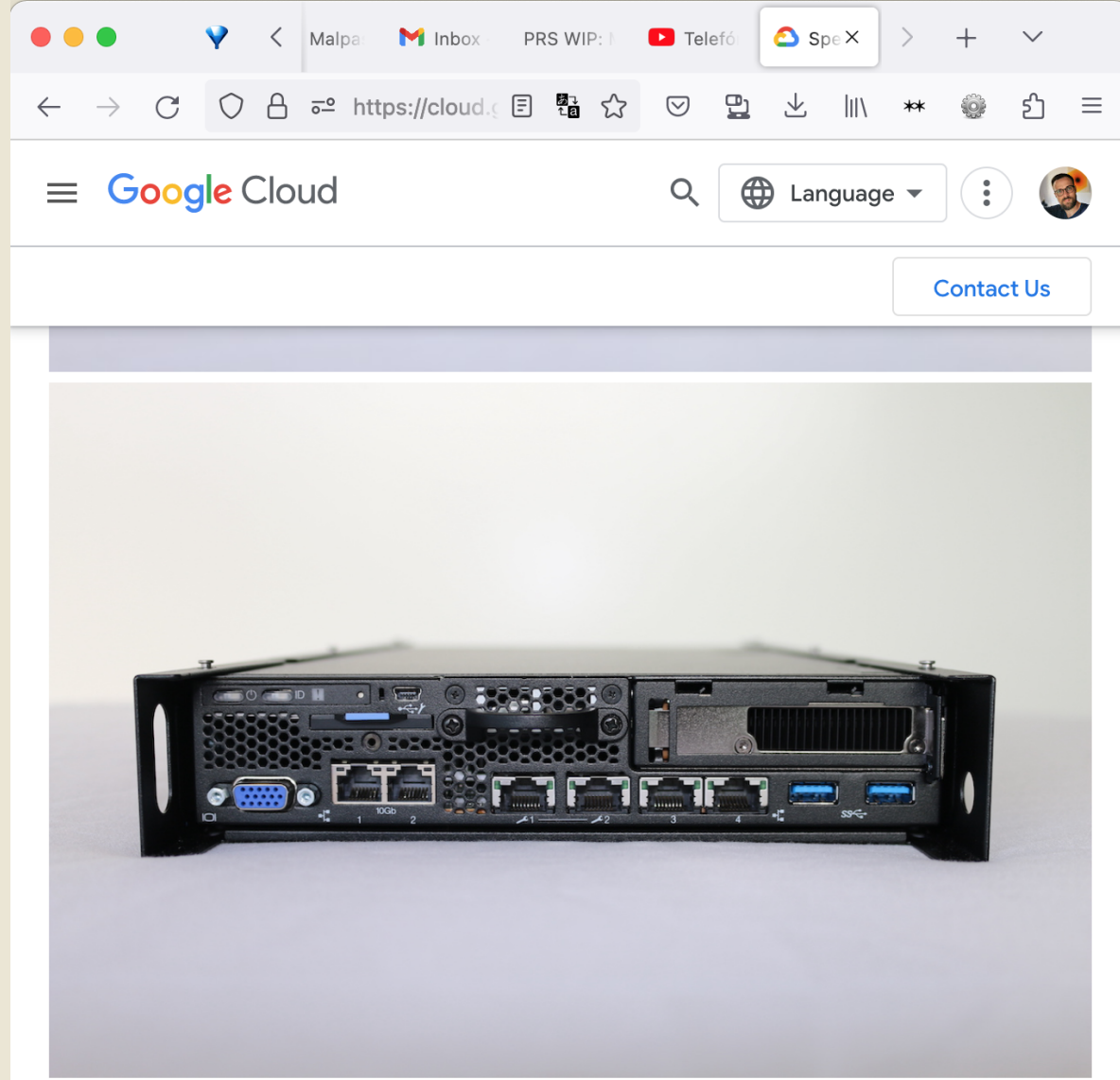
 **Telefónica**
34.3K subscribers [Subscribe](#) 146 Share

35K views 10 years ago
La operadora inaugura su mayor centro de datos que albergará los servicios digitales más avanzados. Alcalá Data Center será un referente internacional en tamaño, seguridad y eficiencia energética. [Show more](#)

- All
- From Telefónica
- Data center
- Listenable
- Recently uploaded

How Does a Data Center Work?
Discovering Data Centers
 2:45
What is a Data Center?
Google Cloud Tech
186K views · 2 years ago

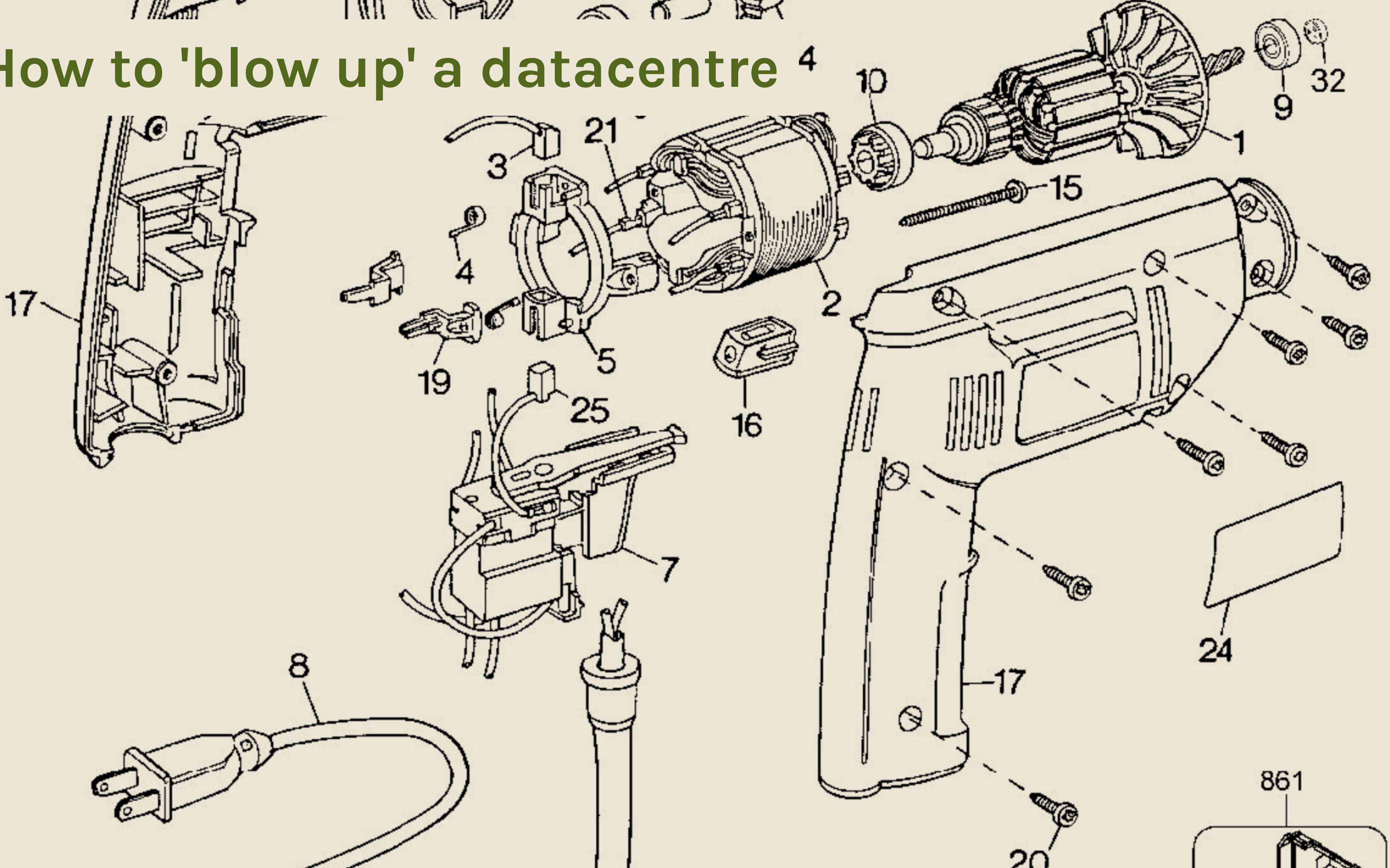
PODCAST
Pantomima Full



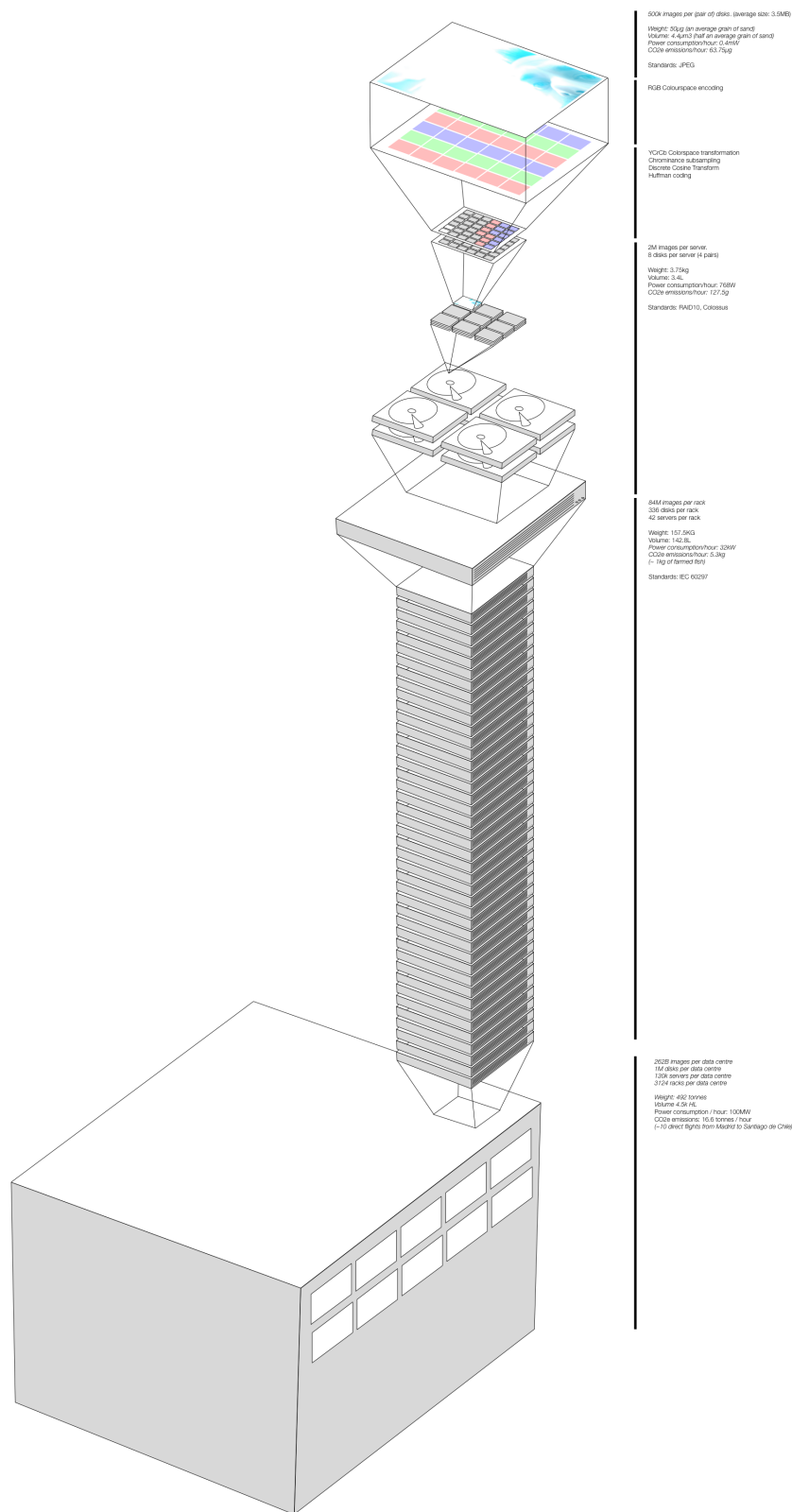
Google Cloud [Contact Us](#)

Specification	EA-STORAGE-10	EA-GPU-T4
Processor	16 core CPU, 64GB RAM	NVIDIA T4 GPU, 16 core CPU, 64GB RAM
Storage	8x 2TB SSDs. Usable storage is 7.2 TB using RAID10.	4x 2TB SSDs. Usable storage is 3.6 TB using RAID10.
Networking	2x 10GBASE-T RJ45, 2x 1GbE RJ45	
Shipping weight	13.6 kg (30 lbs)	
Dimensions	Height: 43 mm (1.7 in.), width: 209 mm (8.2 in.), depth: 376 mm (14.8 in.)	
Mounting options	Horizontal or vertical orientation. Bookshelf mount (3 servers), DIN rail wall mount, ceiling mount, 1U rack mount (2 servers), 2U short-depth rack mount (2 servers). Available locking bezel with dust filter.	

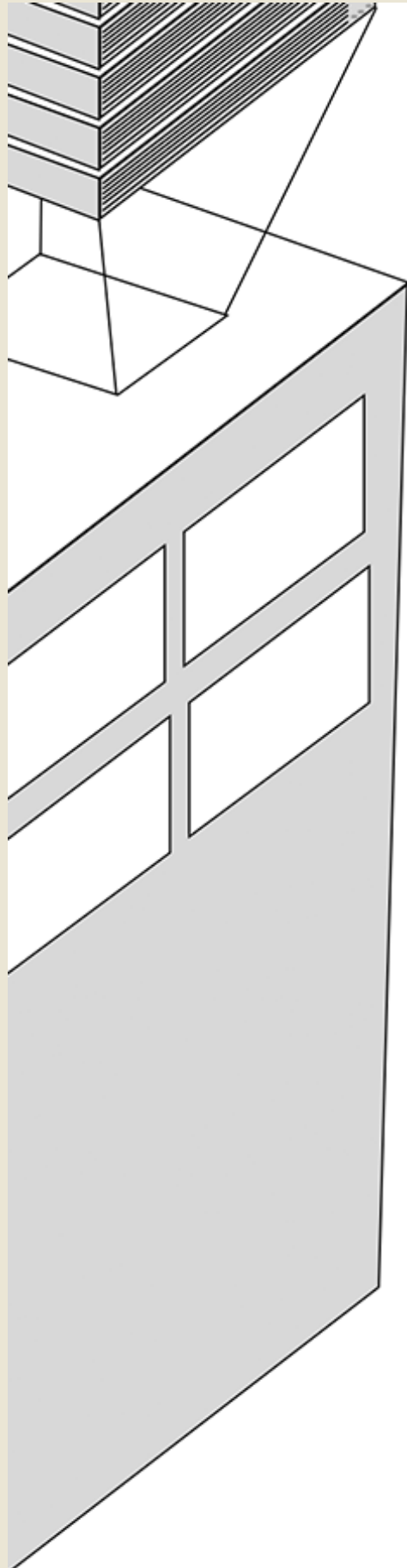
How to 'blow up' a datacentre



How to 'blow up' a datacentre

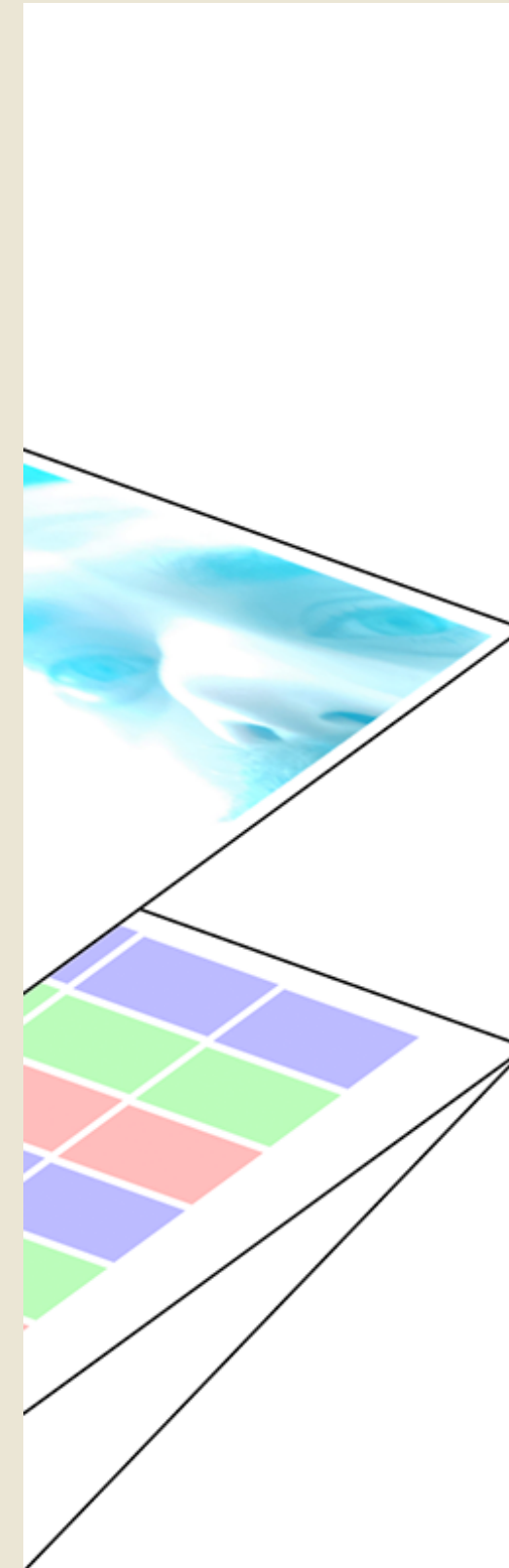


From Refuse to Refusal



262B images per data centre
1M disks per data centre
130k servers per data centre
3124 racks per data centre

Weight: 492 tonnes
Volume 4.5k HL
Power consumption / hour: 100MW
CO₂e emissions: 16.6 tonnes / hour
(~10 direct flights from Madrid to Santiago de Chile)



500k images per (pair of) disks. (average size: 3.5MB)

Weight: 50 μ g (an average grain of sand)
Volume: 4.4 μ m³ (half an average grain of sand)
Power consumption/hour: 0.4mW
CO₂e emissions/hour: 63.75 μ g

Standards: JPEG

RGB Colourspace encoding

YCrCb Colorspace transformation
Chrominance subsampling
Discrete Cosine Transform
Huffman coding

2M images per server.
8 disks per server (4 pairs)

From Refuse to Refusal

permacomputing/ Principles
[Edit](#) [RecentChanges](#) [Preferences](#) [?Discussion](#)

These **design principles** have been modeled after those of **permaculture**.

These are primarily design/practice principles and not philosophical ones, so feel free to disagree with them, refactor them, and (re-)interpret them freely. Permacomputing is not prescriptive, but favours instead situatedness and awareness of the diversity of context. Said differently, its design principles can be as much helpful as a way to guide practice in a specific situation, as it can be used as a device to help surface systemic issues in the relationship between computer technology and ecology.

Care for life

This is the ethical basis that permacomputing builds on. It refers to the permacultural principles of "care for the earth" and "care for people", but can be thought of as the basic axiom for all choices.

Create low-power systems that strengthens the biosphere and use the wide-area network sparingly. Minimize the use of artificial energy, fossil fuels and mineral resources. Don't create systems that **obfuscate waste**.

Care for the chips

Production of new computing hardware consumes a lot of energy and resources. Therefore, we need to **maximize the lifespans** of hardware components - especially **microchips**, because of their low material **recyclability**.

- Respect the quirks and peculiarities of what already exists and **repair** what can be repaired.
- Create new devices from **salvaged components**.
- Support local **time-sharing** within your community in order to avoid buying redundant stuff.
- Push the industry towards **Planned longevity**.
- **Design for disassembly**.

INTERNATIONAL TRANS★FEMINIST DIGITAL DEPLETION STRIKE

[english](#) [español](#) [catalan](#) [français](#) [Deutsch](#) [Nederlands](#) [português](#) [ελληνικά](#) [română](#) [italiano](#) [slovensky](#) [Türkçe](#) [Danish](#) [한국어](#) [ქართული](#)

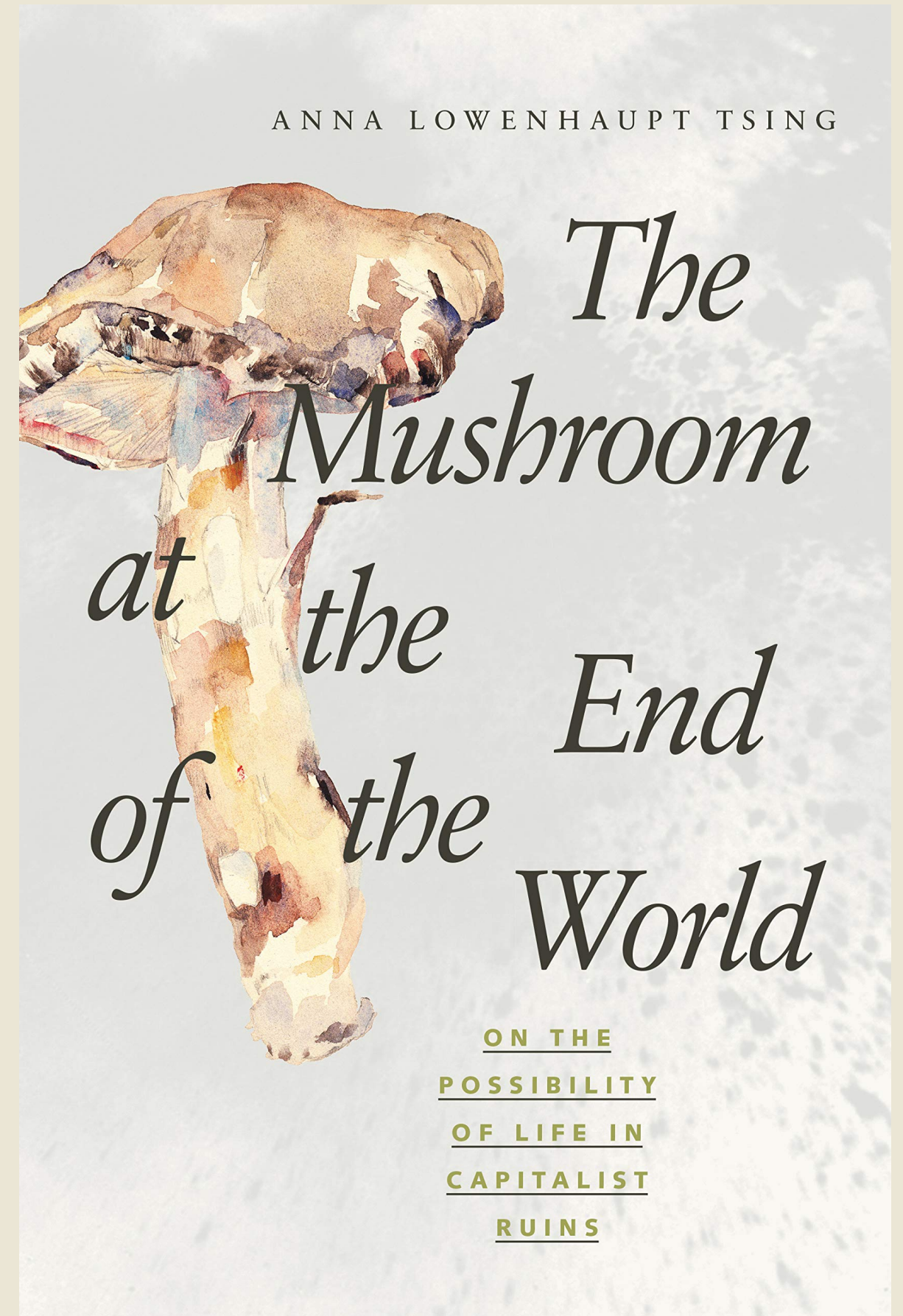
WEDNESDAY 8 MARCH 2023 ✨

On 8th of March 2023, we call for a Counter Cloud Action Day.

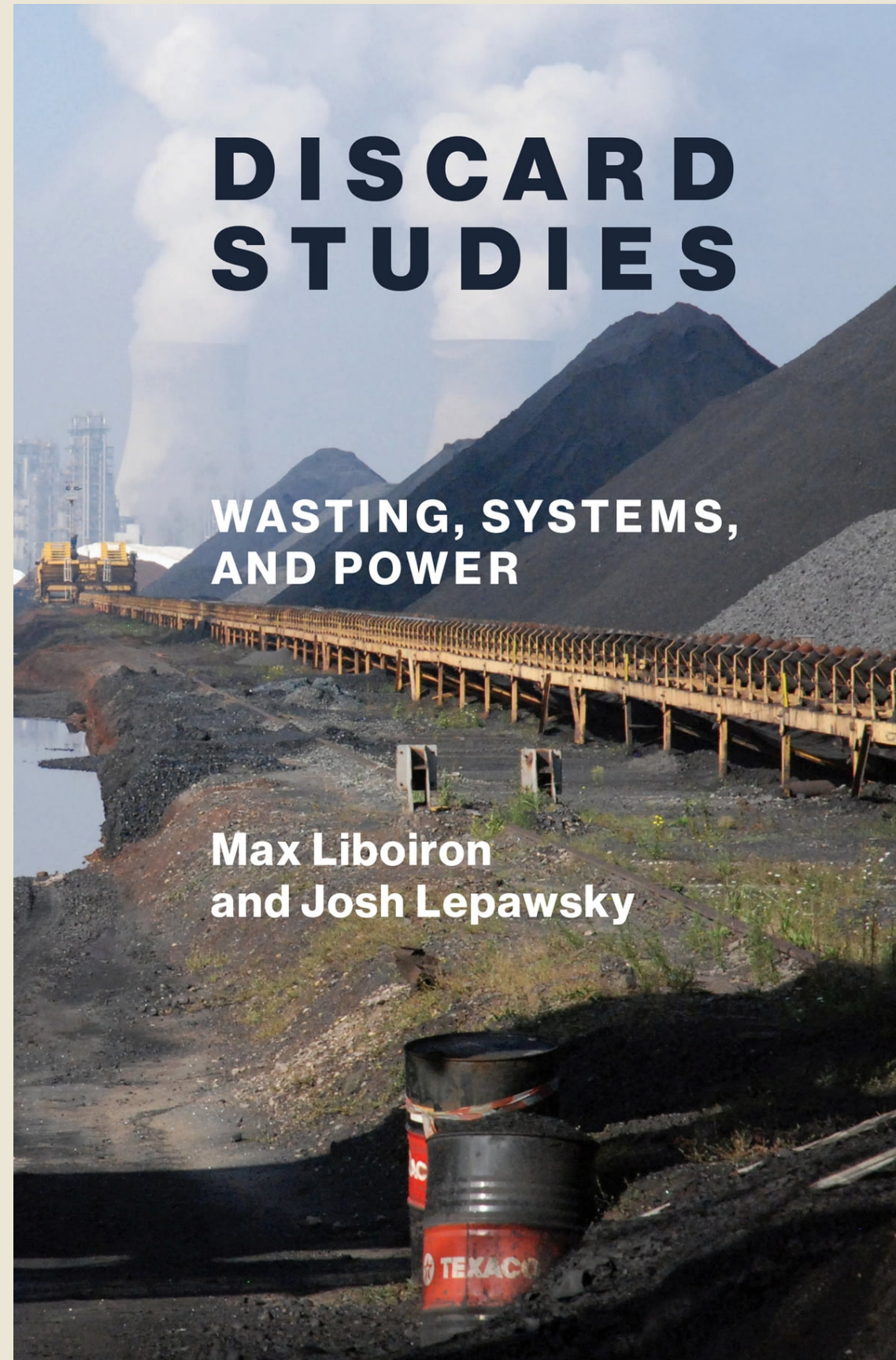
On this day, we will try to withhold from using, feeding, or caring for The Big Tech Cloud. The strike calls for a hyperscaledown of extractive digital services, and for an abundance of collective organising. We join the long historical tail of international feminist strikes, because we understand this fight to be about labour, care, anti-racism, queer life and trans★feminist techno-politics.

Too many aspects of life depend on The Cloud. The expansionist, extractivist and financialized modes of Big Tech turn all lively and creative processes into profit. This deeply affects how we organise, and care for resources. Many public institutions such as hospitals, universities, archives and schools have moved to rented software-as-a-service for their core operations. The interests of Big Tech condition how we teach, make accessibility, learn, know, organise, work, love, sleep, communicate, administrate, care, and remember.

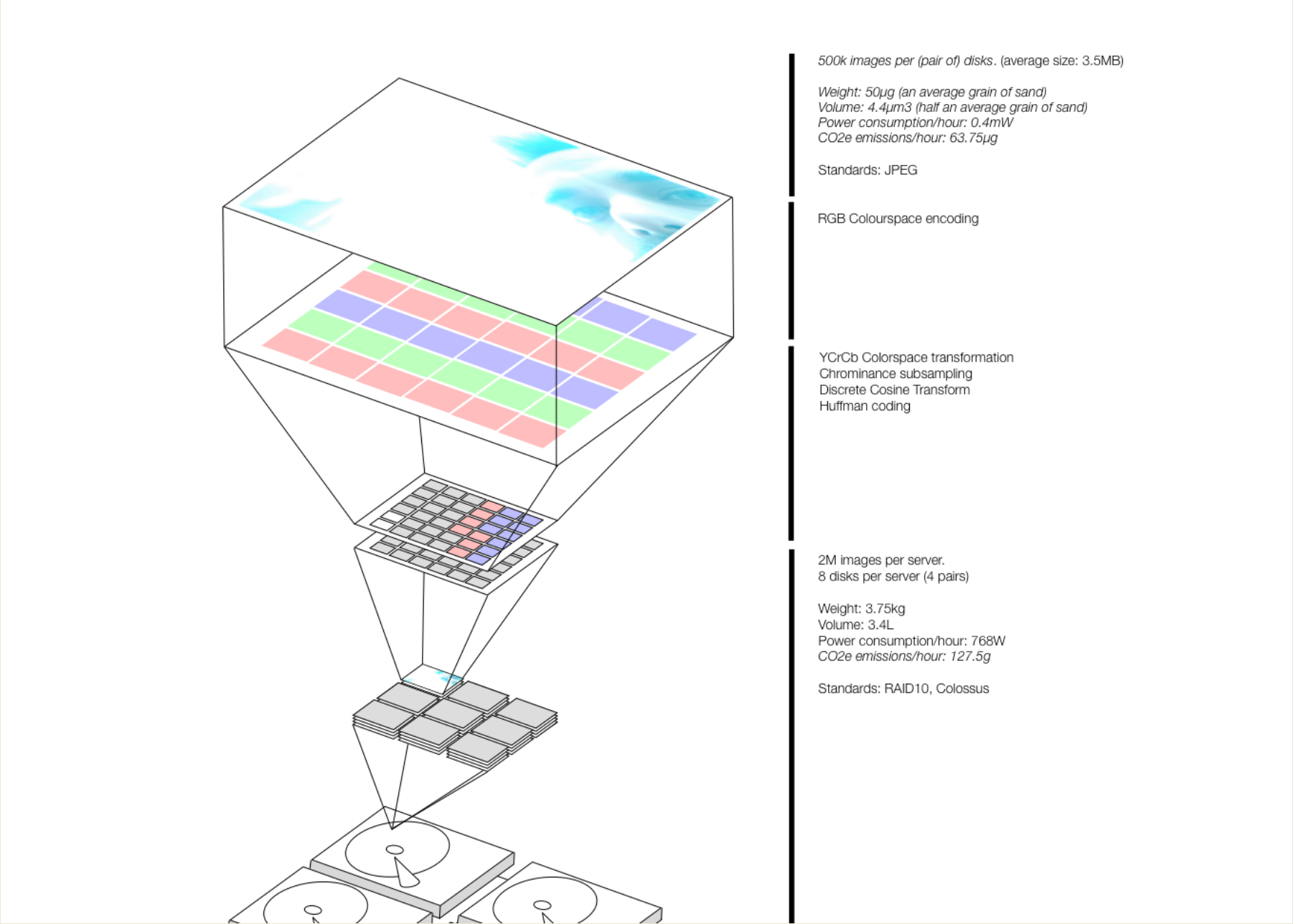
Especially now our dependency on Big Tech Cloud seems intractable, it is time



"Discarding well"



Software as infrastructure

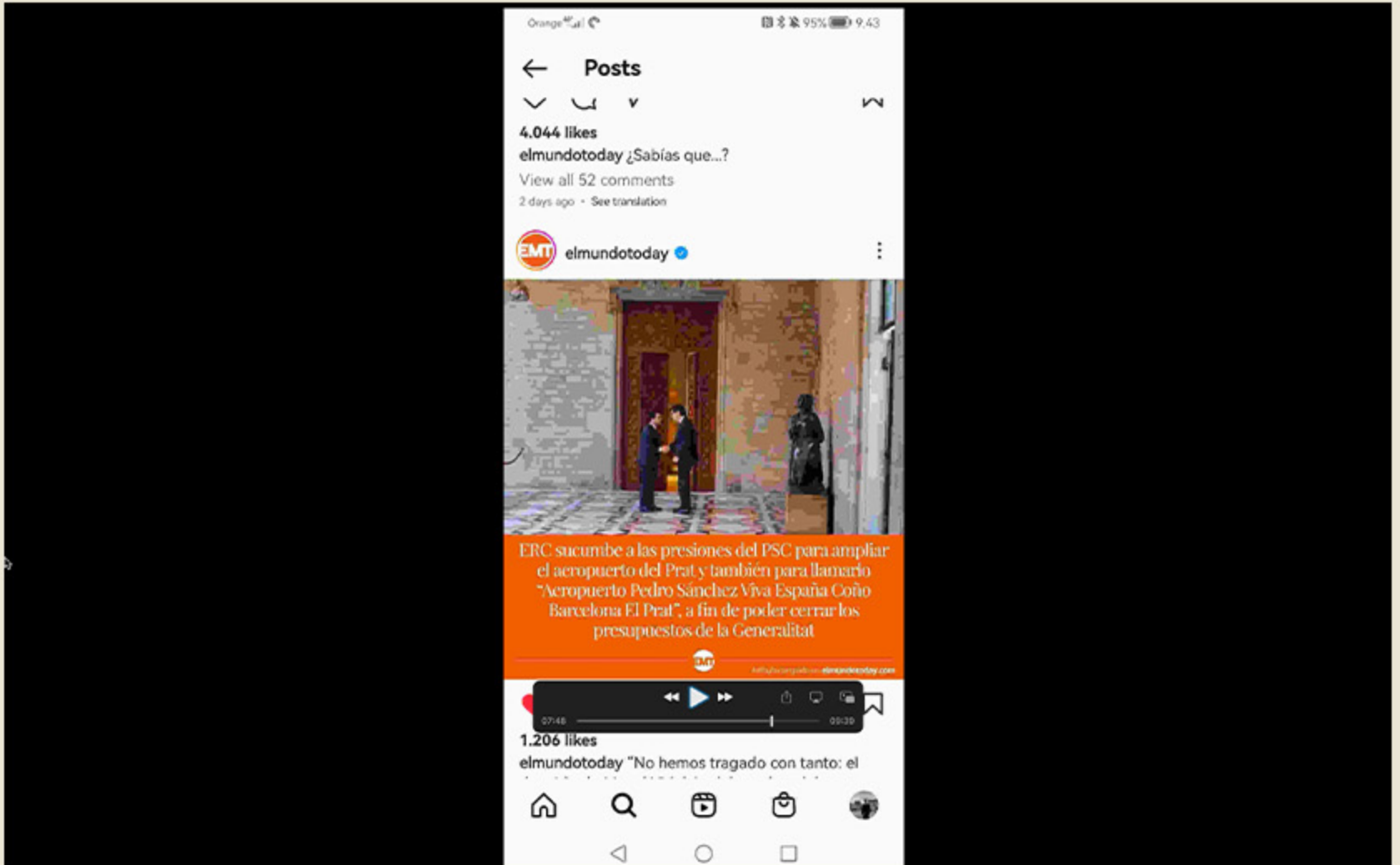


Corruption vs Compression

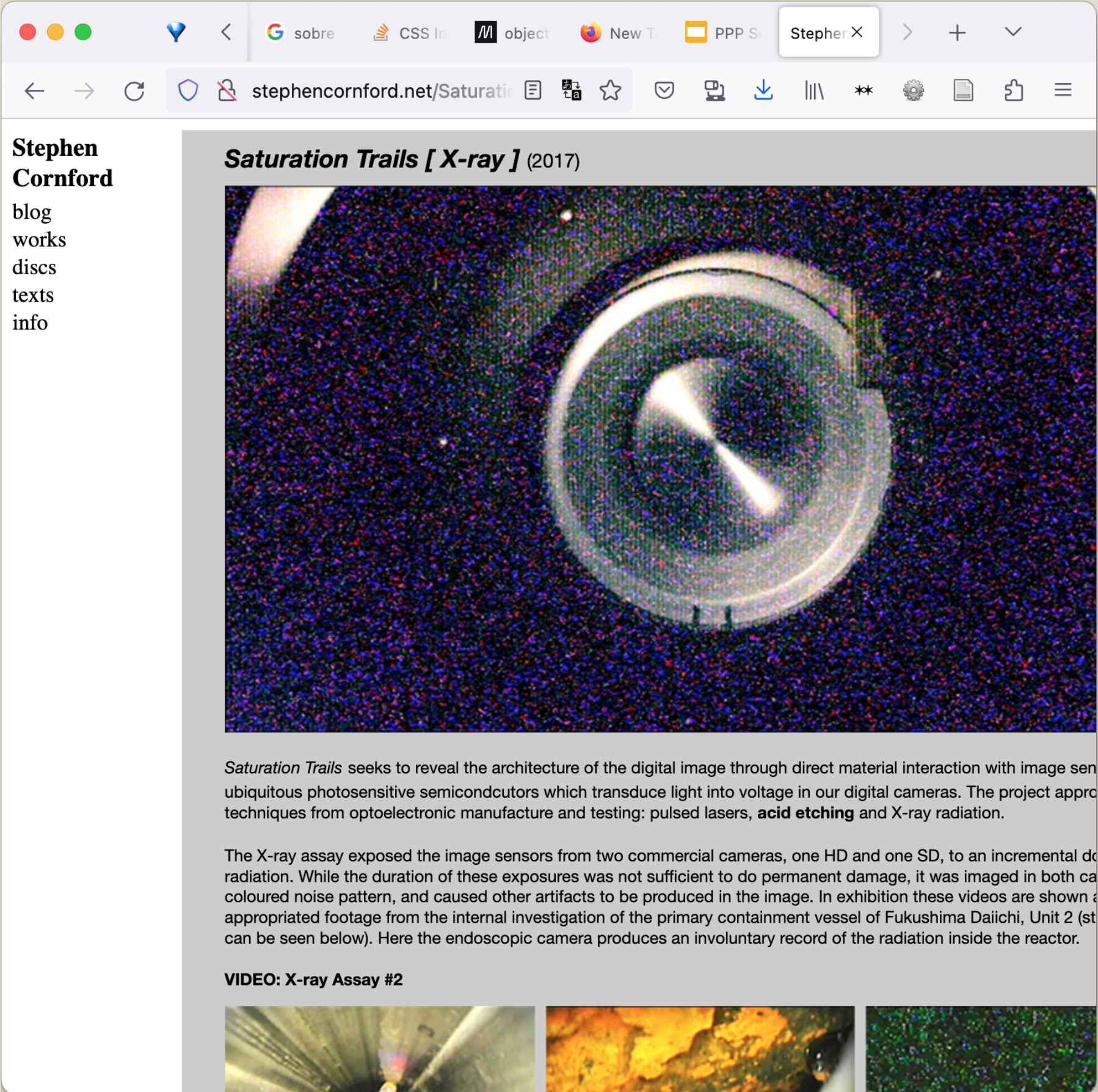


Reframing her questions in the context of *Saturation Trails* leads us to consider not just the interconnected equipment within the laboratory as a holistic apparatus but the FAST Lab and Clean Room's existence within a research unit which attracts considerable funding and can therefore afford to devote time to "continuing the quest for lateral, non-linear ideas" (ORC website). We might also look to Winchester School of Art's merger with a University whose primary focus is science and engineering as a key component of the apparatus that enabled the collaborations at the heart of this research project. Barad's expansive conception of the research apparatus has some confluence with Gilbert Simondon's concept of the technical ensemble, of which he offers the laboratory as a higher-level example. However, unlike Barad, Simondon distinguishes the bounds of the ensemble from its milieu, so for him, the funding environment would be part of the laboratory's milieu rather than part of the ensemble itself.

Combining Barad's expanded definition of the apparatus with Simondon's definition of the technical ensemble, we can conceptualise the meeting of my Panasonic Lumix compact camera and the Coherent Mira laser oscillator as a hinge between the apparatus of optoelectronic research and the technical ensemble of the consumer camera. The laser assay then provides an instance of feedback between these two mutually reliant domains. The image sensor, whose uptake as a consumer device relies on its claim to objectivity garnered through its use in research

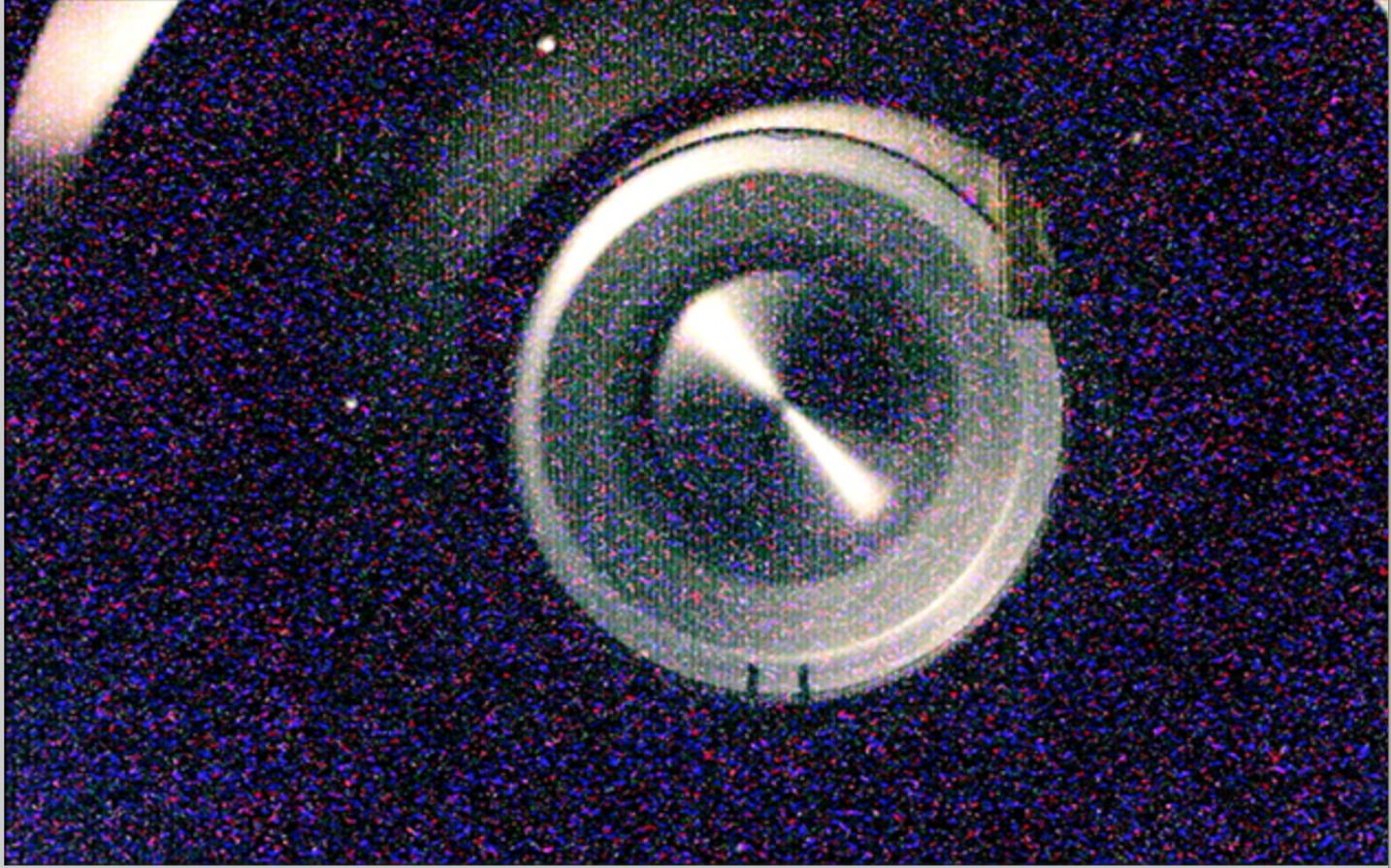


Corruption vs Compression



Stephen Cornford
blog
works
discs
texts
info

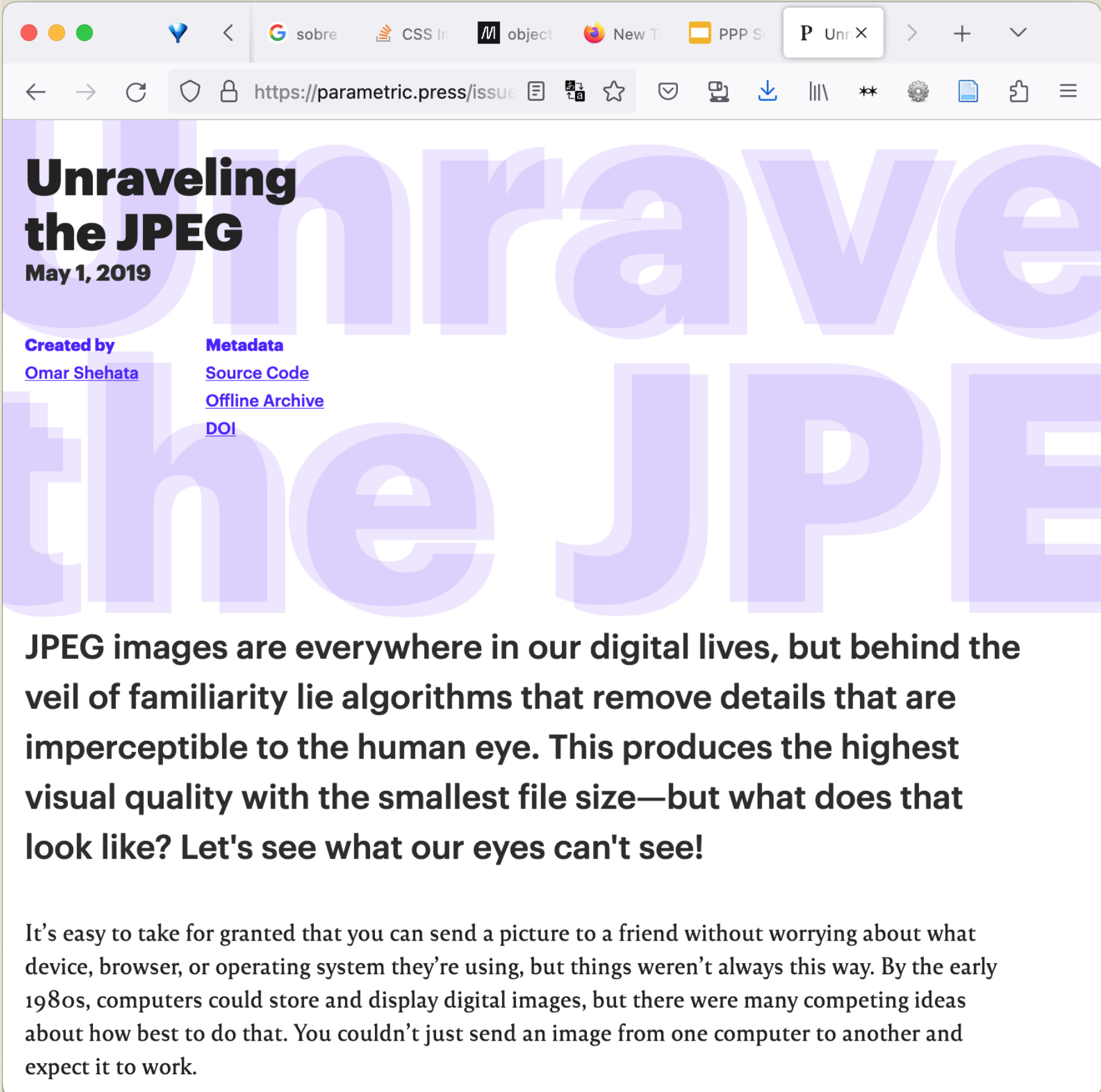
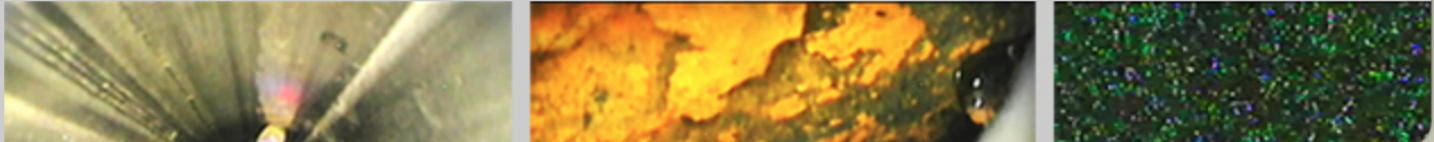
Saturation Trails [X-ray] (2017)



Saturation Trails seeks to reveal the architecture of the digital image through direct material interaction with image sensors using ubiquitous photosensitive semiconductors which transduce light into voltage in our digital cameras. The project approaches techniques from optoelectronic manufacture and testing: pulsed lasers, **acid etching** and X-ray radiation.

The X-ray assay exposed the image sensors from two commercial cameras, one HD and one SD, to an incremental dose of radiation. While the duration of these exposures was not sufficient to do permanent damage, it was imaged in both cameras, producing a colorful noise pattern, and caused other artifacts to be produced in the image. In exhibition these videos are shown as appropriated footage from the internal investigation of the primary containment vessel of Fukushima Daiichi, Unit 2 (still images can be seen below). Here the endoscopic camera produces an involuntary record of the radiation inside the reactor.

VIDEO: X-ray Assay #2



Unraveling the JPEG

May 1, 2019

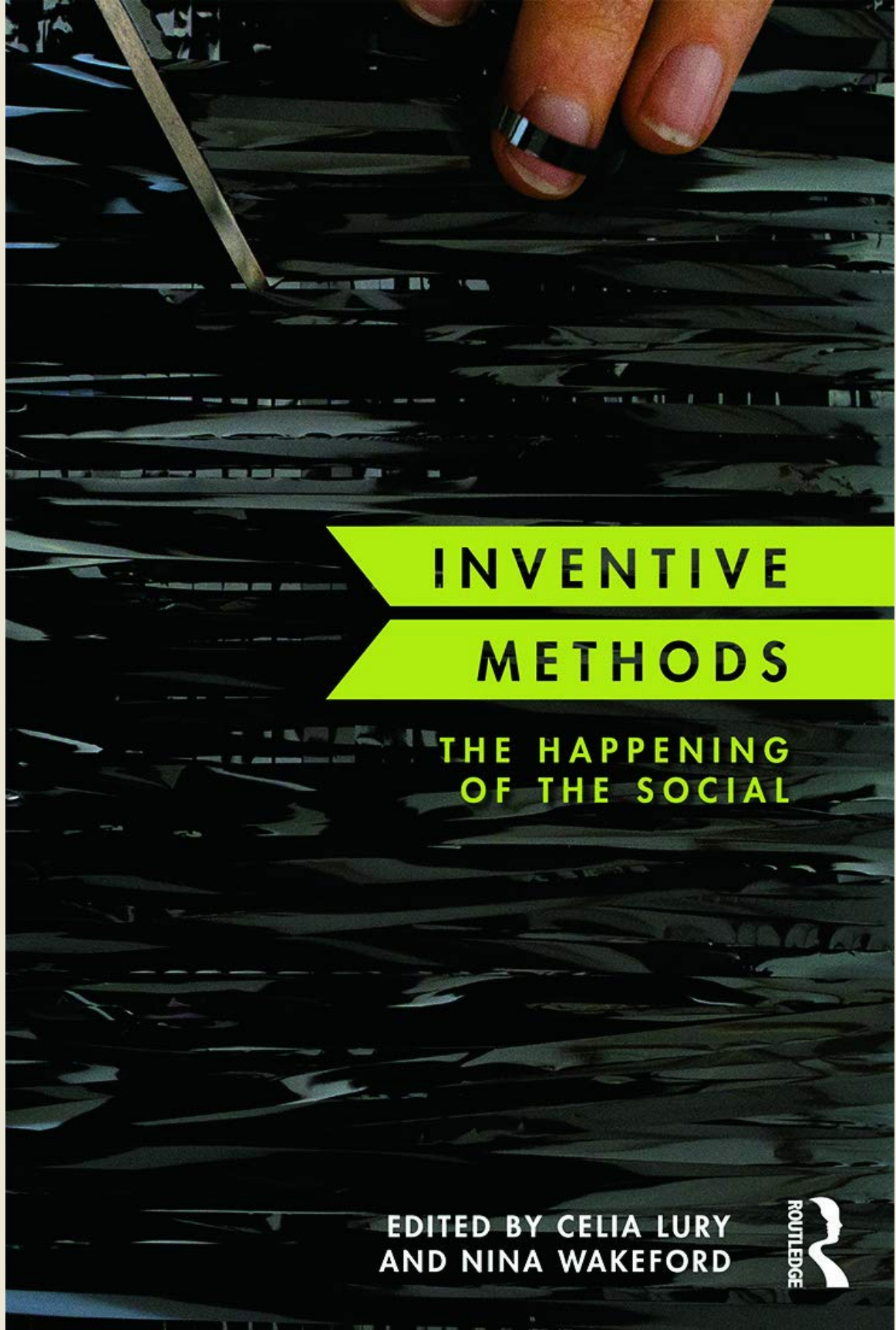
Created by
[Omar Shehata](#)

Metadata
[Source Code](#)
[Offline Archive](#)
[DOI](#)

JPEG images are everywhere in our digital lives, but behind the veil of familiarity lie algorithms that remove details that are imperceptible to the human eye. This produces the highest visual quality with the smallest file size—but what does that look like? Let's see what our eyes can't see!

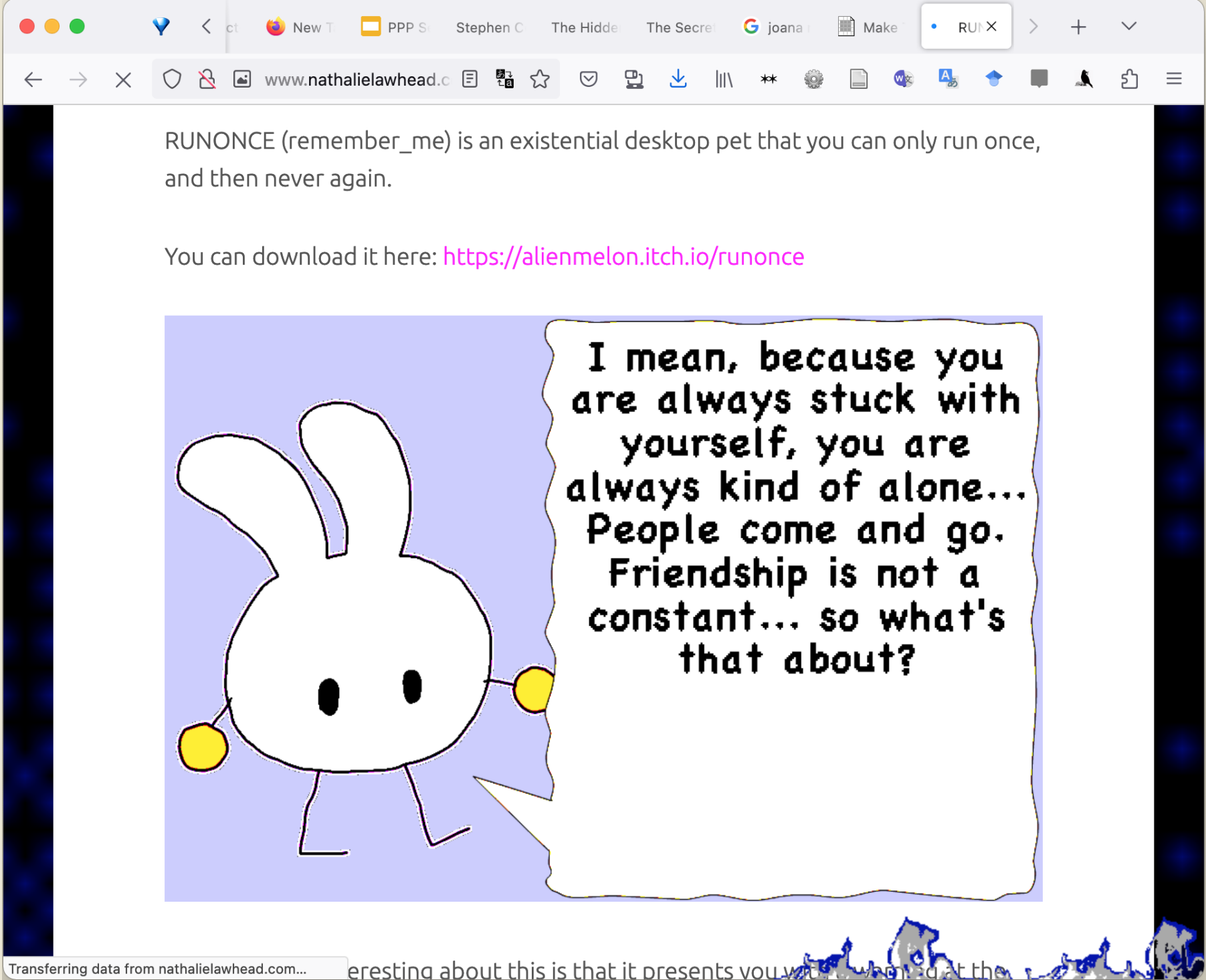
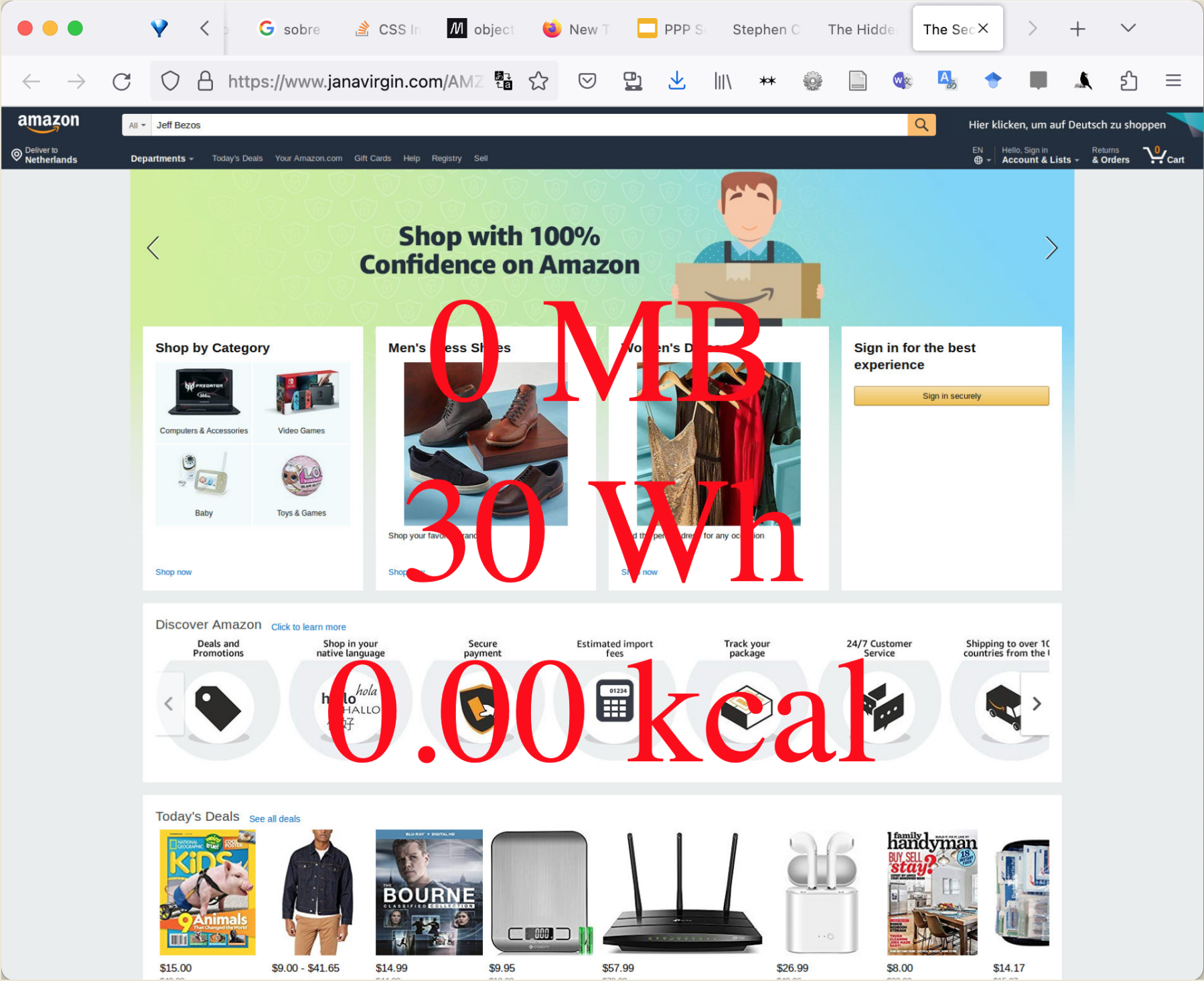
It's easy to take for granted that you can send a picture to a friend without worrying about what device, browser, or operating system they're using, but things weren't always this way. By the early 1980s, computers could store and display digital images, but there were many competing ideas about how best to do that. You couldn't just send an image from one computer to another and expect it to work.

Speculative software interventions



BEYOND
SPECULATIVE
DESIGN:
PAST -
PRESENT
- FUTURE

Speculative software interventions



Writing a thesis, materially.

This is, (or will be) my doctoral thesis - currently a work in progress. It is hosted entirely on an old laptop which was headed for the scrapheap - when that laptop goes offline this site will disappear. The text below is an incomplete draft. To watch my progress (on both the text and the thesis-laptop as a material object) have a look here.

1.5 How to read this thesis.

TO DO Supertext, references, experiments, etc.

CHAPTER 2: ON THE MODE(S) OF EXISTENCE OF DIGITAL WASTES

Digital objects, digital wasting and the pre-materiality of digital wastes

2.1 Introduction

Up until now, I've treated *digital waste* as a term with an obvious, apparent definition. However in order to continue this inquiry, we will need to place this definition on a firmer footing, and in doing so, interrogate the relationship between digital wastes, other digital objects, digital infrastructures, and their users. In popular usage, *digital waste* is commonly used to mean two distinct things - discarded digital devices, and the wastes produced in their manufacture and ongoing use (also known as e-waste), and discarded virtual objects - the data, files, media or messages that inhabit our computer trash cans or sit forgotten about on phones, desktops, or servers, and which, as discussed in the previous chapter, are experienced in multiple ways, exist at multiple scales, and have multiple materialities.

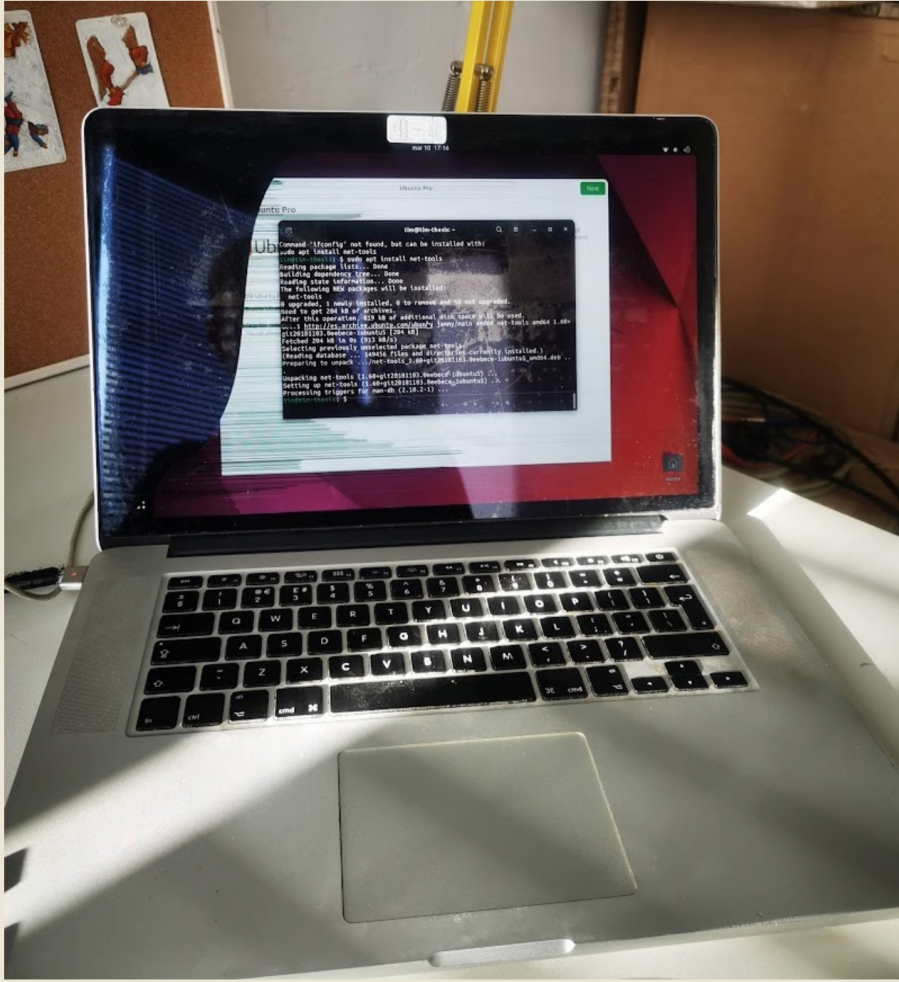
While the former meaning - *physical* digital wastes, or discarded electronic devices has been the subject of study in multiple fields - notably the field of *Discard Studies* (Lepawsky, 2018; Akese, 2019) - the latter - which I will provisionally term *virtual* digital wastes, while an issue of concern in technology journalism and popular writing (Beck, 2012; Godoy, 2021), so far lacks more sustained study in an academic context: save its analysis as a behavioural phenomenon (Sweeten, Sillence and Neave, 2018; Neave et al., 2019), or a medical condition (van Bennekom et al., 2015). The goals of this thesis are to argue that virtual digital wastes, as objects which are present in our digital lives in multiple ways merit more sustained analysis, and that such analysis can both be carried out *through* design practice, and has important consequences for such practice - topics which will be the subject of later chapters.

However, while I have begun to identify some of the ways in which these digital

Ecologies of Excess

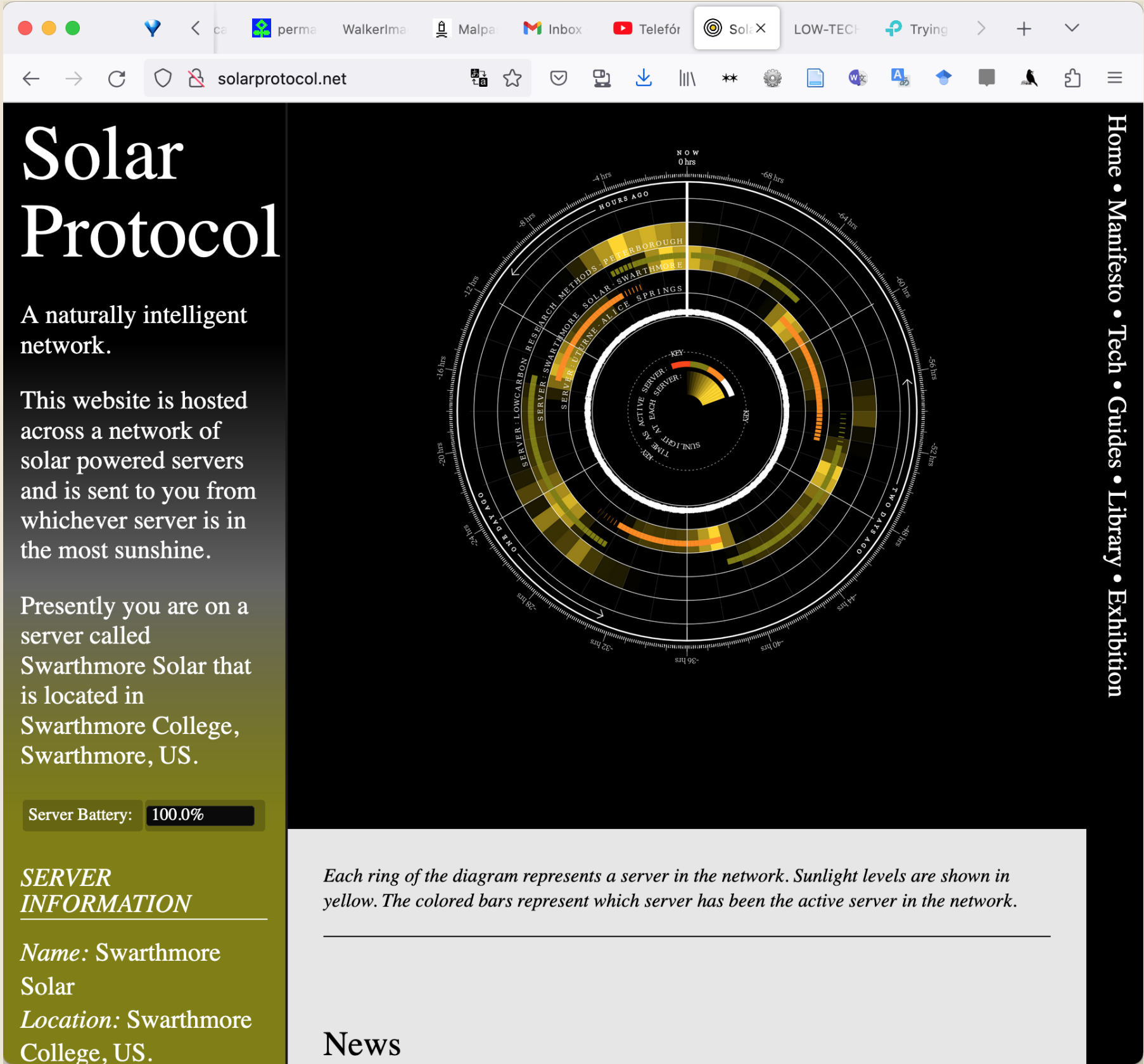
← Back

COLOPHON



This thesis is hosted on a 2014 MacBook Pro with a cracked screen, a battery that won't hold charge for more than about 20 minutes, and which I had left at the bottom of box of miscellaneous 'gadgets' for the best part of the last three years, after the stained portion of the screen finally got too big for it to be useful as a laptop.

Writing a thesis, materially.



Solar Protocol

A naturally intelligent network.

This website is hosted across a network of solar powered servers and is sent to you from whichever server is in the most sunshine.

Presently you are on a server called Swarthmore Solar that is located in Swarthmore College, Swarthmore, US.

Server Battery: 100.0%

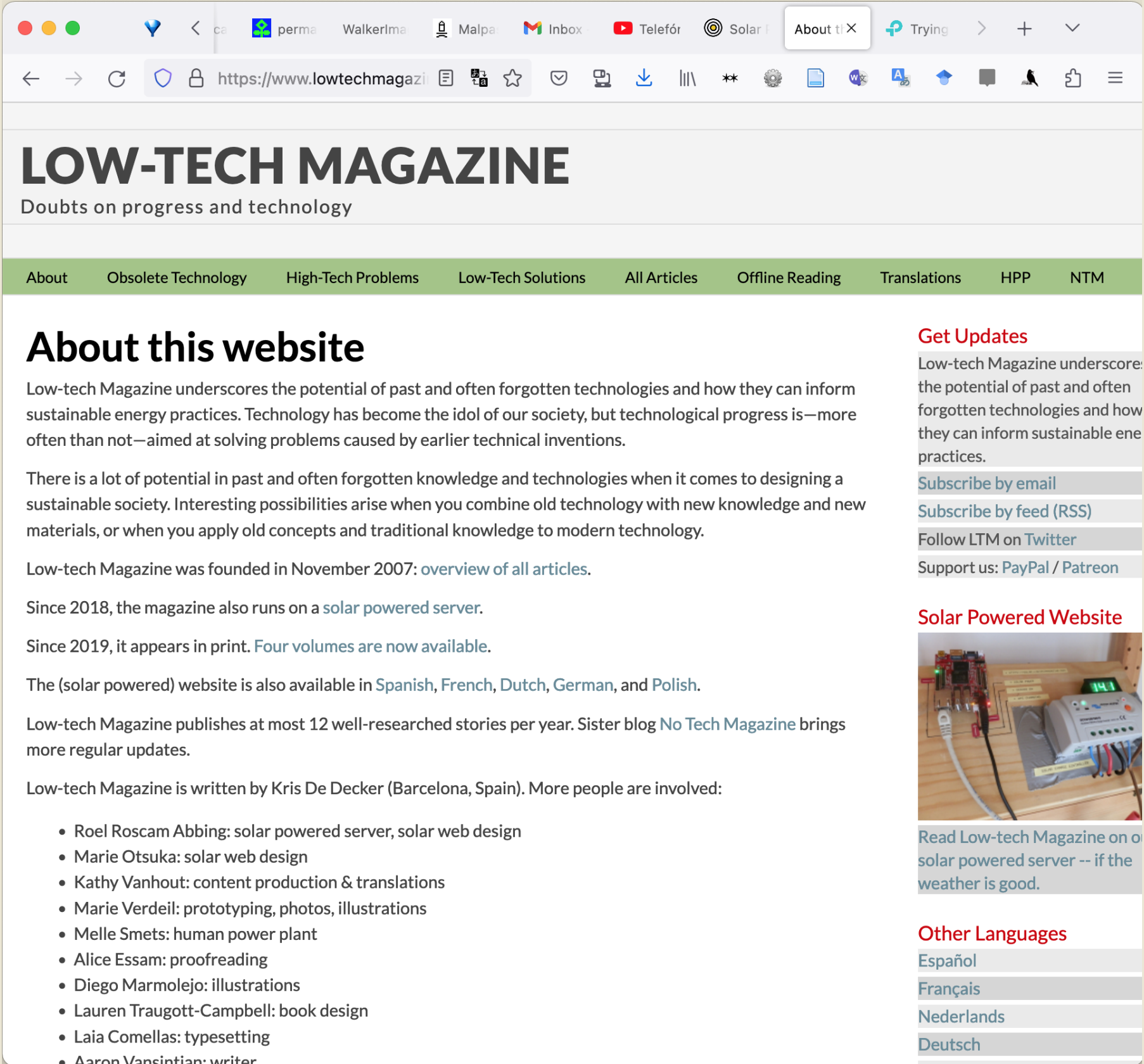
SERVER INFORMATION

Name: Swarthmore Solar
Location: Swarthmore College, US.

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Each ring of the diagram represents a server in the network. Sunlight levels are shown in yellow. The colored bars represent which server has been the active server in the network.

News



LOW-TECH MAGAZINE
Doubts on progress and technology

About • Obsolete Technology • High-Tech Problems • Low-Tech Solutions • All Articles • Offline Reading • Translations • HPP • NTM

About this website

Low-tech Magazine underscores the potential of past and often forgotten technologies and how they can inform sustainable energy practices. Technology has become the idol of our society, but technological progress is—more often than not—aimed at solving problems caused by earlier technical inventions.

There is a lot of potential in past and often forgotten knowledge and technologies when it comes to designing a sustainable society. Interesting possibilities arise when you combine old technology with new knowledge and new materials, or when you apply old concepts and traditional knowledge to modern technology.

Low-tech Magazine was founded in November 2007: [overview of all articles](#).

Since 2018, the magazine also runs on a [solar powered server](#).

Since 2019, it appears in print. [Four volumes](#) are now available.

The (solar powered) website is also available in [Spanish](#), [French](#), [Dutch](#), [German](#), and [Polish](#).

Low-tech Magazine publishes at most 12 well-researched stories per year. Sister blog [No Tech Magazine](#) brings more regular updates.

Low-tech Magazine is written by Kris De Decker (Barcelona, Spain). More people are involved:

- Roel Roscam Abbing: solar powered server, solar web design
- Marie Otsuka: solar web design
- Kathy Vanhout: content production & translations
- Marie Verdeil: prototyping, photos, illustrations
- Melle Smets: human power plant
- Alice Essam: proofreading
- Diego Marmolejo: illustrations
- Lauren Traugott-Campbell: book design
- Laia Comellas: typesetting
- Aaron Vansintian: writer

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Solar Powered Website



[Read Low-tech Magazine on our solar powered server -- if the weather is good.](#)

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Conclusions

- The environmental harms of cloud technologies are *systemic*, the result of a pervasive *logic of scalability*.
- For this reason, focusing on individual choice and behaviour is marginal. This presents a challenge for design practice.
- Responding to this challenge involves taking an *ecological* view of digital media, and enlarging the purview of design away from the interface.

Thank you!

- `tim@timcowlshaw.co.uk`
- `@mistertim@assemblag.es` (mastodon/fedi)
- `https://www.timcowlshaw.co.uk`