CALCULATING EMPIRES

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THE OVERWHELMING NOW
KATE CRAWFORD | VLADAN JOLER

How can we understand the pervasive power of technology at this moment in history and its role in our lives? How did computational systems develop from historical practices of communication, classification, and control, and vice versa? And what are the material impacts of planetary-scale technology on our planet? "Calculating Empires" is designed to look behind the current spectacles of artificial intelligence and ask how we got here—and to consider where we might be going. The exhibition charts a way of seeing the technological present by immersing us in the past: a genealogical countermeasure to the current *technological presentism*.

In 2023, generative artificial intelligence flooded global culture, and became the fastest adopted consumer technology of all time. Millions of people changed the way they search, write, and make images. But these systems have already shown a capacity to concentrate power, produce 'hallucinations' and misinformation at scale, and challenge the perception of a shared reality.

Beyond the influences on politics and public discourse, generative AI has a significant impact on our ecologies, requiring vast amounts of energy, water, and minerals. And all of these diverse global impacts— from the political to the material—are hard to track. They are intentionally obscured by a growing culture of corporate secrecy and proprietary information, as well as the complexities of supply chains, opaque labor contracting arrangements, and a lack of legal imperatives for transparency and accountability. The political ecologies of contemporary technology are notoriously hard to see at scale.

Even when technologies feel radically new, they gradually follow the same trajectory: they become ambient, quotidian, invisible. Our smartphones, video conference calls, and social media streams have faded, becoming background muzak that sets a subtle tempo and tenor for our days. Similarly, generative AI, which has seemed so unexpected and powerful will soon melt into normalcy. The full operations of AI are masked

behind text boxes and touchscreens, behind corporate brands and algorithmic apologies, behind secret supply chains, and outsourced sweatshops.

We are rarely given the tools to look within the systems: to see how they are made, what they are doing, and how much they truly cost over the *longue durée*. Computational technologies have deep roots and unpredictable legacies. They are the result of centuries of industrialization, imperialism, scientific experimentation, capital concentration, political transformation, and cultural acceleration. To see all this at work requires a different kind of map.

THE EXHIBITION

Curated by researcher-artists Kate Crawford and Vladan Joler, "Calculating Empires" exhibition project charts our technological present by depicting how power and technology have been intertwined since 1500. By merging research and design, science and art, Crawford and Joler create a new way to understand the current spectacles of artificial intelligence by asking how we got here—and consider where we might be going. This mind-expanding installation invites visitors to experience the longue durée through a visualization of time, politics, and technology historically obscured by cultures of corporate secrecy and technical architectures, the complexities of colonialism, planetary supply chains, opaque labor contracting, a lack of regulation, and by history itself.

The centerpiece of the exhibition is the *Calculating Empires* Map Room. Here the audience is immersed in a dark environment—like walking into a literal black box. Presenting itself as a codex of technology and power, *Calculating Empires* shows how the empires of the past 500 years are echoed in the technology companies of today. This detailed visual narrative extends over 24 meters and illustrates forms of communication, classification, computation, and control with thousands of individually crafted drawings and texts that span centuries of conflicts, enclosures, and colonizations. One map reveals the multiplicity of our communication devices, interfaces, infrastructures, data practices, and computational architectures and hardware. The other map explores how these technologies are woven into social prac-

tices of classification and control: from prisons to policing, time to education, colonialism and economic production, to the multitude of military systems.

To contextualize this new work, the visitor first encounters Crawford and Joler's *Anatomy of an AI System*, an exploded view diagram focusing on the case study of the Amazon Echo voice-assisted AI. This anatomical map visualizes the three central extractive processes required to run any large-scale AI system: material resources, human labor, and data. Where *Calculating Empires* is about time, *Anatomy of an AI System* is about space.

The exhibition concludes in a cabinet of curiosities, an eclectic collection of books, devices, and ephemera spanning from 1500 to 2023, and in a small library that invites visitors to read, reimagine, and write their own additions, revisions, and complications of history. Any exhibition that spans centuries will necessarily be incomplete, impartial, and subjective: it can never be finished. So these maps are designed to be open to feedback, and to change over time.

FIFTH FLOOR
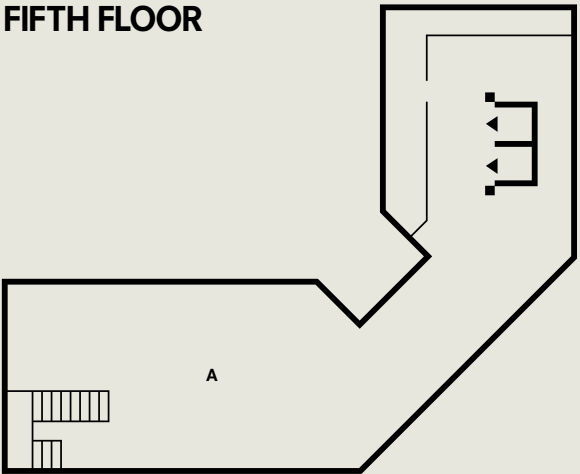
A. ANATOMY OF AN AI SYSTEM

A. ANATOMY OF AN AI SYSTEM

Simon Denny
Document Relief 1, 3, 22 (Amazon Worker Cage patent), 2019–20. Ink jet print on archival paper, glue, custom metal. Courtesy of the Artist and Galerie Buchholz, Berlin / Cologne / New York
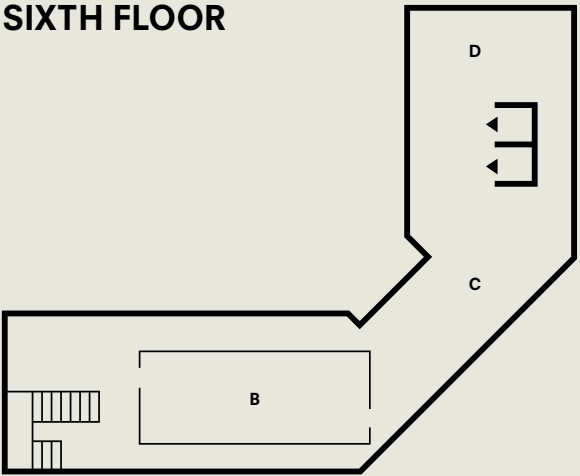
1. Kate Crawford and Vladan Joler, *Anatomy of an AI System: The Amazon Echo as an Anatomical Map of Human Labor, Data and Planetary Resources*, 2018, https://anatomyof.ai [essay]

2. Kate Crawford and Vladan Joler, *Anatomy of an AI System: The Amazon Echo as an Anatomical Map of Human Labor, Data and Planetary Resources*, 2018 [map]

3. Vladan Joler, *New Extractivism*, 2021, video animation by Živa Stanojević and Aleksandar Ilić, sound by Igor Lečić

4. *The Exciting life of Internet Packet*, SHARE Lab – collection of slides, 2015–21

5. Amazon Echo exploded view

6. Bauxite
   Al – Aluminum
   Bosnia
   Wiring in microchips, heat sinks for cooling, CPUs, graphic processors, electric power lines
   Toxicity: =

7. Emerald
   Be – Beryllium
   China
   Telecommunications infrastructure equipment, computers, and cellular phones
   Toxicity: toxic

8. Ga – Gallium
   China
   Advanced semiconductors for microwave transceivers, DVDs, laser diodes in compact discs, and other electronic applications
   Toxicity: –

9. Tourmaline
   B – Boron
   Brasil
   Nanowires
   Toxicity: toxic

10. Pyrolusite
    Mn – Manganese
    Germany
    Primary cathode material in lithium-ion manganese (NCM) batteries
    Toxicity: moderate

11. Wolframite and silica
    W – Wolfram (Tungsten)
    China
    Tungsten is one of the most important components in modern integrated circuitry
    Toxicity: highly toxic (compounds)

12 Nd – Neodymium
China
Strong permanent magnets and lasers
Toxicity: slightly toxic

13 Muscovite
K – Potassium
Serbia
Potassium-ion batteries or K-ion batteries
Toxicity: toxic (hyperkalemia)

14 Stibnite
Sb – Antimony
China
Diodes and infrared detectors
Toxicity: toxic

15 Erythrite
Co – Cobalt
Democratic Republic of the Congo
Rechargeable batteries, semi-conductors, hard disk drives,
and integrated circuits
Toxicity: toxic

16 Ammonite in oil shale
Oil shale
Russia
Liquid fuels
Toxicity: pollutant

17 Quartz
Si – Silicon
Serbia
Silicon wafers
Toxicity: high (silicosis)

**18 Large crystals of Zinc, Lead, and Arsenopyrite with Quartz
and Pyrite**
Zn+As – Zinc and Arsenic
Kosovo
Arsenic: integrated circuits
Zinc: low-field thin-film transistors, transparent conducting
oxide contacts, sensing
Toxicity: toxic (Arsenic)

19 Halite
Li – Lithium
Bolivia
Lithium-ion batteries
Toxicity: toxic (Lithium overdose)

20 Magnesite with Silicon carbide vein and Brucite
Mg – Magnesium
Turkey
PVC replacement. Heat transfer and dissipation
Shield electromagnetic and radio frequency interference;
casings for hard drives, cameras, cell phones, laptops, and
portable media devices
Toxicity: toxic (Lithium overdose)

21 Uvarovite
Cr – Chromium
Russia
Protection of metal surfaces against corrosion in electrical
and electronic equipment, particularly for coating of
electro-galvanized steel and aluminum
Toxicity: high (cancer)

22 Cadmium Smithsonite
Cd – Cadmium
UK
Batteries and electroplating
Toxicity: toxic

23 Spodumene
Li – Lithium
Democratic Republic of the Congo
Lithium-ion batteries
Toxicity: toxic (Lithium overdose)

24 S – Sulfur
Bolivia
Ore processing
Toxicity: low

25 Cassiterite
Sn+Ta
Tin and Tantalum
Democratic Republic of the Congo
Tin: solders
Tantalum: electrical circuits, capacitors, resistors
Toxicity: moderately

26 Coal
C – Carbon
Serbia
Coal is primarily used as a fuel
Toxicity: pollutant

27 Native Copper
Cu – Copper
Poland
Electrical wiring, electronics circuitry
Electrical contacts
Toxicity: toxic

28 Hematite
Fe – Iron
Morocco
Hard drives, magnetic cards, transformers, motors
generators, speakers
Toxicity: toxic (Iron overdose)

29 Monazite
REE – Nd, La, S, U, Th
Czech Republic
Magnets, electrodes, and carbon-arc lighting, as a catalyst
in catalytic converters and for precision glass polishing
Toxicity: toxic waste

30 Svalerit (Zinc) and Galenit (Lead) base with traces of Titanium, Nickel, Iron, Gold, Silver, Wolfram, and Arsenic
Au+Ag+Ti – Gold, Silver, and Titanium
Kosovo
Gold: connectors, switch and relay contacts, soldered joints, connecting wires and connection strips. Silver: printed circuit boards to switches and TV screens. Silver membrane switches, which require only a light touch, are used in buttons on televisions, telephones, microwave ovens, children's toys, and computer keyboards. Titanium: computers, mobile phones, wearable devices

31 Malachite
Cu – Copper
Democratic Republic of the Congo
Electrical conductor in many categories of electrical wiring
Toxicity: toxic

32 Apatite
P – Phosphorus
Pakistan
Semiconductors, insulators, imaging tools, night vision devices, mid-infrared optical modulators, on-chip spectroscopy
Toxicity: toxic

33 Cinnabar
Hg – Mercury
Mexico
LCD screens and monitors, laptop screen shutoffs, batteries
Illegal gold mining
Toxicity: highly toxic

34 Patents
US Patent No. US20150066283A1, "System and method for transporting personnel within an active workspace," Amazon Technologies Inc, 2015.
US Patent No. US1142740 B2, "High density, robotic warehouse system," Amazon Technologies Inc, 2022.
US Patent No. US10096319B1, "Voice-based determination of physical and emotional characteristics of users," Amazon Technologies Inc, 2018.
US Patent No. US11632456B1, "Call based emotion detection," Amazon Technologies Inc, 2023.
US Patent No. US11195408B1 "Sending signals for help during an emergency event," Amazon Technologies Inc, 2021.
US Patent No. US2017/0175413A1, "Multi-level fulfillment center for unmanned aerial vehicles," Amazon Technologies Inc, 2017.
US Patent No. US994222B1, "Authentication with wearable device," 2018.
US Patent No. US10511810B2, "Accessing cameras of audio/video recording and communication devices based on location," 2019.

SIXTH FLOOR

B. CALCULATING EMPIRES
C. DISPLAY CASES
D. BOOKS

B. CALCULATING EMPIRES

35 Kate Crawford and Vladan Joler, *Calculating Empires: A Genealogy of Technology and Power, 1500-2025*, 2023

C. DISPLAY CASES

36 Carl Linnaeus, *Wästgöta Resa* (Wästergötland travel), Gothenburg, 1928

37 Athanasius Kircher, *World Geological Map Volcanoes, Ocean Currents & Chasms*, 1665

38 Georgius Agricola, *De re metallica* (On the matter of metal), 1556

39 Philip II of Spain, silver 1 Reales Spanish Colonial Cob Coin, Mexico, *c.* 1556–98

40 Matthaeus Merian, map of Milan, 1646

41 Matthew Fontaine Maury, *The Physical Geography of the Sea*, New York, 1885

42 Jacob Bohme, *The Signature of All Things*, 1664

43 Aristotle, *Historia Animalium* (History of animals), 1558

44 Alain Manesson Mallet, *Description de l'univers. De la sphère* (Description of the universe. The globe), plate LXVII, 1683

45 James W. Redfield, *Comparative Physiognomy or Resemblances between Men and Animals*, New York, 1853

46 Cesare Lombroso, *L'uomo delinquente* (The delinquent man), vol. 2, Turin, 1889

D. BOOKS

John Evelyn, *Sylvia, or a Discourse of Forest Trees*, 1664

John Locke, *Two Treatises on Government*, 1690

Pierre-Joseph Proudhon, *What Is Property? Or, An Inquiry into the Principle of Right and of Government*, 1840

G.B. Duchenne de Boulogne, *The Mechanism of Human Facial Expression*, 1862

Gabriel Tarde, *Laws of Imitation*, 1890

Lord Bacon, *Novum Organum or True Suggestions for the Interpretation of Nature*, 1901

Galileo Galilei, *Dialogue Concerning the Two Chief World Systems*, 1953

Philip Morrison, Phylis Morrison, Office of Charles and Ray Eames, *Powers of Ten: About the Relative Size of Things in the Universe and the Effect of Adding Another Zero*, 1982

William Aspray, *John von Neumann and the Origins of Modern Computing*, 1990

Henri Lefebvre, *The Production of Space*, [1974] 1991

Thomas Richards, *The Imperial Archive: Knowledge and the Fantasy of Empire*, 1993

Michael Foucault, *The Order of Things: An Archaeology of the Human Sciences*, [1966] 1994

Paulo Freire, *Pedagogy of the Oppressed*, [1970] 1996

Claude E. Shannon and Warren Weaver, *The Mathematical Theory of Communication*, [1949] 1998

Fredrich A. Kittler, *Gramophone, Film, Typewriter*, [1986] 1999

Ian Hacking, *The Emergence of Probability: A Philosophical Study of Early Ideas about Probability, Induction and Statistical Inference*, [1957] 2006

Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*, 2007

Lorraine Daston, *Objectivity*, 2007

Umberto Eco, *The Infinity of Lists*, 2009

Critical Cartography, SHARE Lab and Friends, 2014–18

Simone Browne, *Dark Matters: On the Surveillance of Blackness*, 2015

Donna Haraway, *Simians, Cyborgs, and Women: The Reinvention of Nature*, [1991] 2015

Tung-Hui Hu, *A Prehistory of the Cloud*, [1978] 2015

Yuk Hau, *The Question Concerning Technology in China: An Essay in Cosmotechnics (Urbanomic/Mono)*, 2016

Achille Mbembe, *Necropolitics (Theory in Forms)*, [2016] 2019

Martin Arboleda, *Planetary Mine: Territories of Extraction under Late Capitalism*, 2020

James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*, [1998] 2020

Oscar H. Gandy Jr., *The Panoptic Sort: A Political Economy of Personal Information*, [1993] 2021

Kate Crawford, *Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence*, 2022

Justin Smith-Ruiu, *The Internet Is not What You Think it Is: A History, a Philosophy, a Warning*, 2022

Ifeoma Ajunwa, *The Quantified Worker*, 2023

Vladan Joler, Francesco D'Abbraccio, Andrea Facchetti, Kate Crawford, and Daphne Dragona, *Black Box Cartography – A critical cartography of the Internet and beyond*, 2023