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Nature, Opal, Photonic Crystal

Erik Demaine, Paper & Glass

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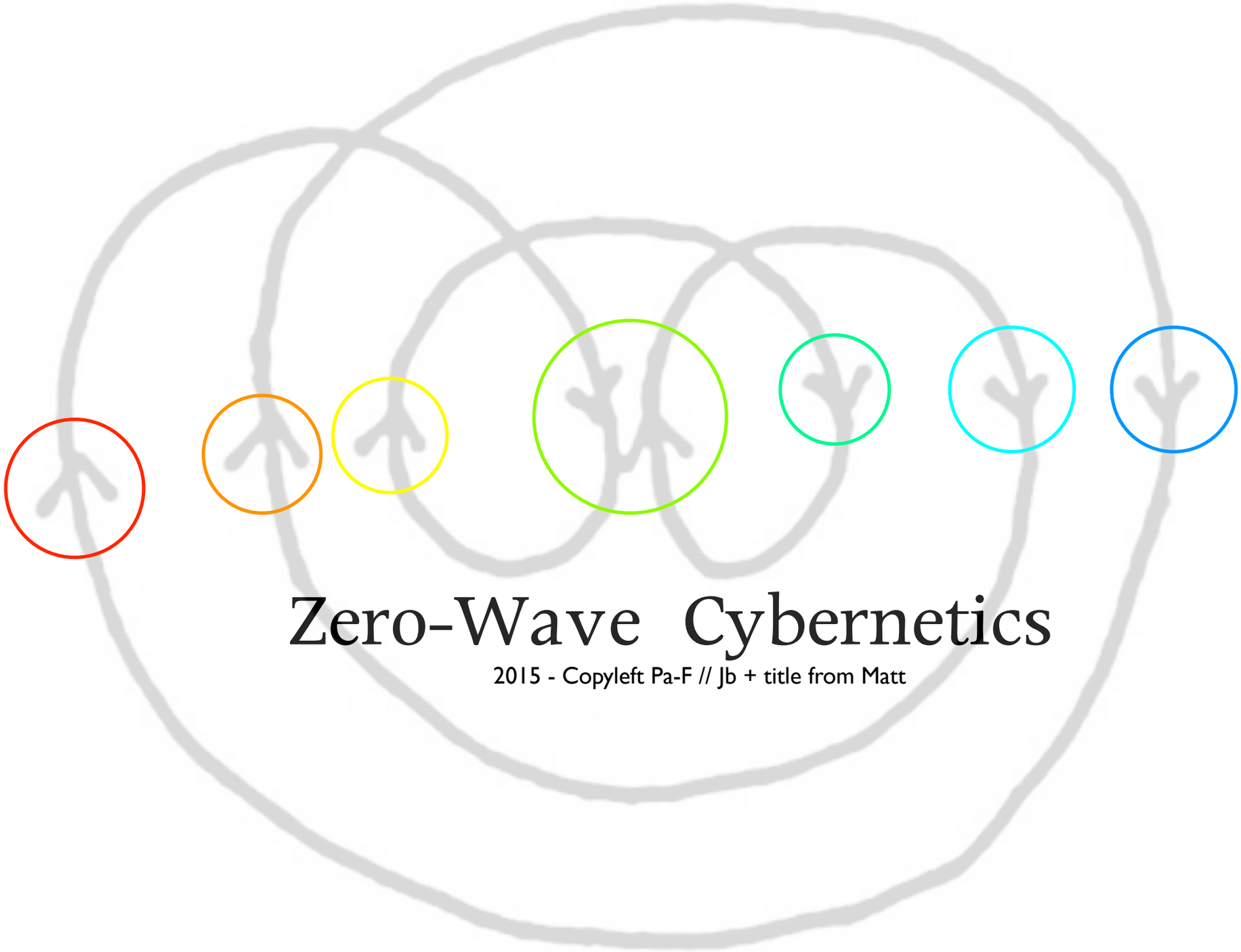

Zero-Wave Cybernetics

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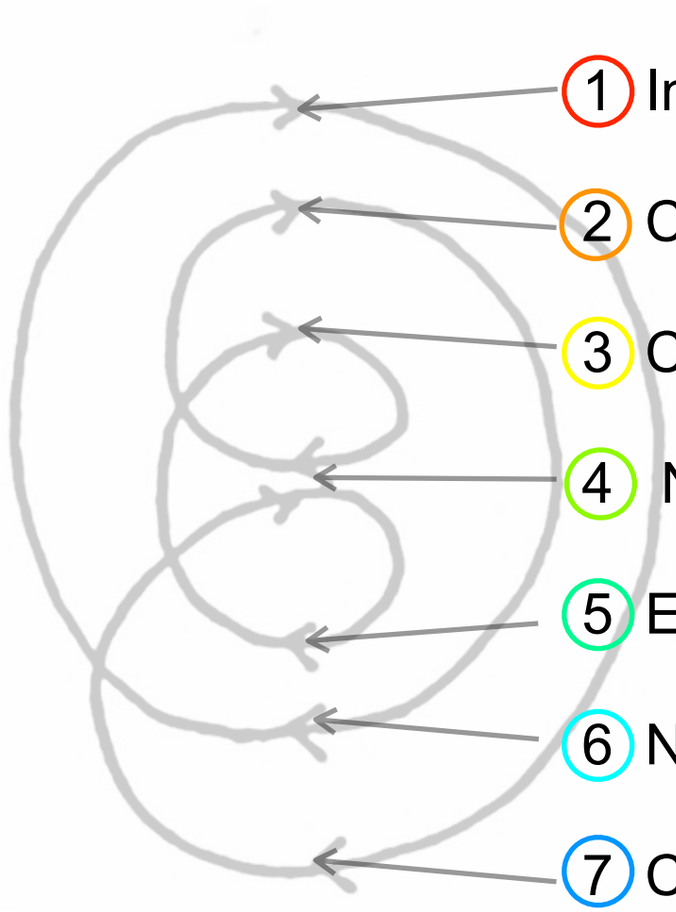

1. Incoherents / Alphonse Allais
2. CryptoMyths / Dogons / Monte-Verita / Eranos / Discordianism
3. Cybernetics / Solvay / Macy / Wiener / McCulloch
4. Non-Ordinary Computation / Léo Szilard / Rala & Fleet / Programmable Matter
5. Exaptation (morphogenesis, architecture, embryology) Symbiosis
6. NeoCybernetics / Bateson / Thom Catastrophy Theory
7. Complexity / Scale Theory / Folding (geometry/topology reconciliation, neurulation)

MYSTAGOGUES

TRICKSTERS

a. Alchemy, Archemy, Spagyria

b. Supra-natural Shamanism, dance, metaphor, psychopomp, gymnosophy

c. Tensegrity

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Farceurs vs mystificateurs
Tricksters vs Mystagogues

Playing

Chaos
עולם התהו
Complexity / Self-Ref
In/Multi-Determinism

Nature

Automation

Artificial

Initiation

Path
Trajectory
Linearity / Teleology
Determinism

Rite

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MIMESIS

Spatio-Temporality of Nature -> Supra-Natural (Roberte Hamayon)
Spatio-Temporality of Rite -> Symbolic Forms (Ernst Cassirer)
Spatio-Temporality of Automata -> Artificial, Virtual (Herbert Simon)

≠ by-scales (effets d'échelle)
≠ by-products (effets de bord)

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Incoherents

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ALPHONSE ALLAIS
(ŒUVRES ANTHUMES)

Deux et deux font cinq

(2 + 2 = 5)

PARIS
PAUL OLLENDORFF, ÉDITEUR
28 *bis*, RUE DE RICHELIEU, 28 *bis*

1895

Tous droits réservés.

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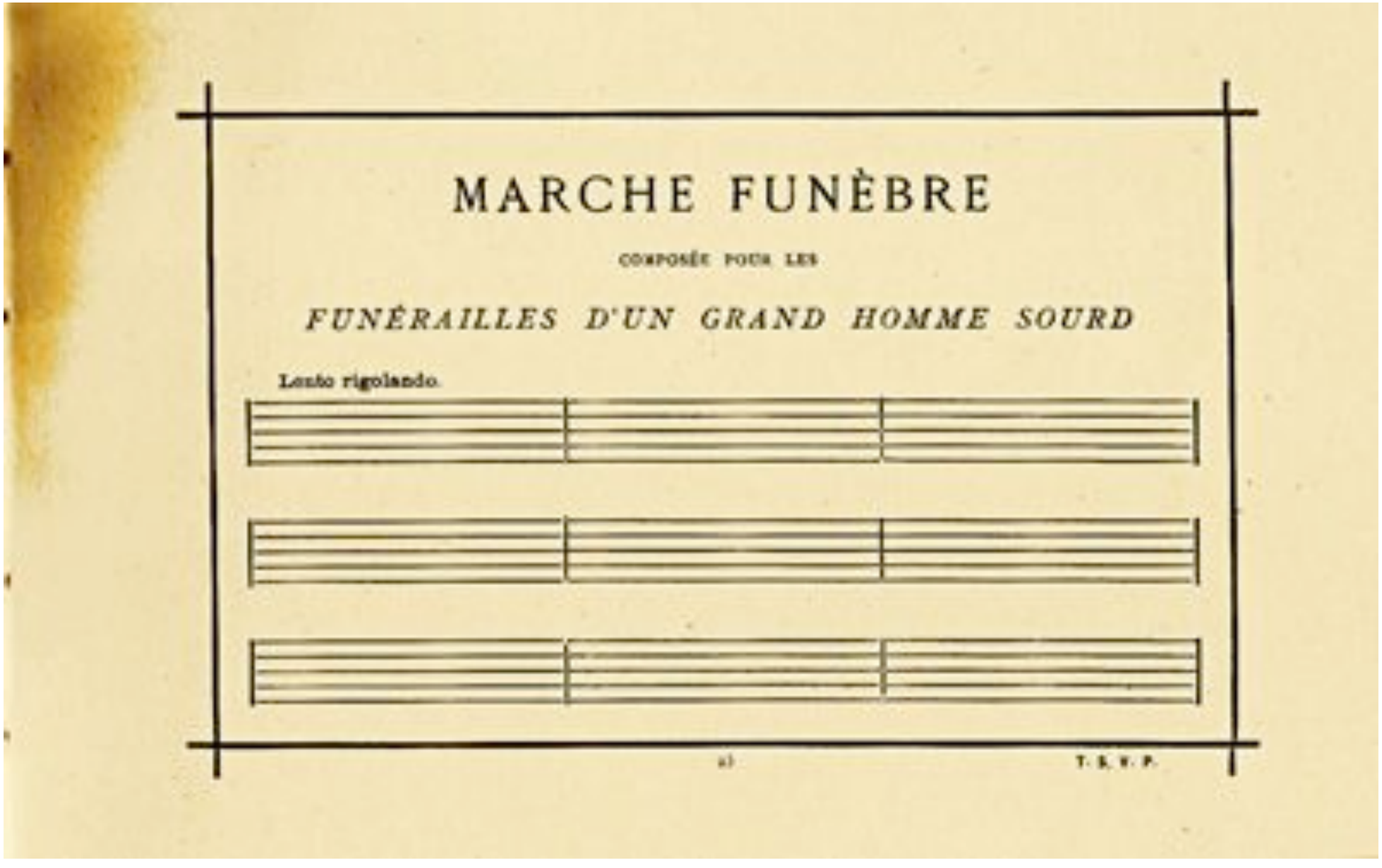

MARCHE FUNÈBRE

COMPOSÉE POUR LES

FUNÉRAILLES D'UN GRAND HOMME SOURD

Lento rigolando.

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ALPHONSE ALLAIS

Album Primo-Avrilesque

COMPOSÉ

1° D'une spirituelle préface par l'auteur;
2° De *sept magnifiques planches* gravées en taille-douce et de différentes couleurs ;
3° D'une seconde Préface presque aussi spirituelle que la première,

Et enfin

D'une marche funèbre spécialement composée pour les funérailles d'un grand homme sourd.

PRIX : UN FRANC

PARIS. — PAUL OLLENDORFF, EDITEUR, 28 bis, rue de Richelieu

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PREMIÈRE COMMUNION DE JEUNES FILLES CHLOROTIQUES
PAR UN TEMPS DE NEIGE

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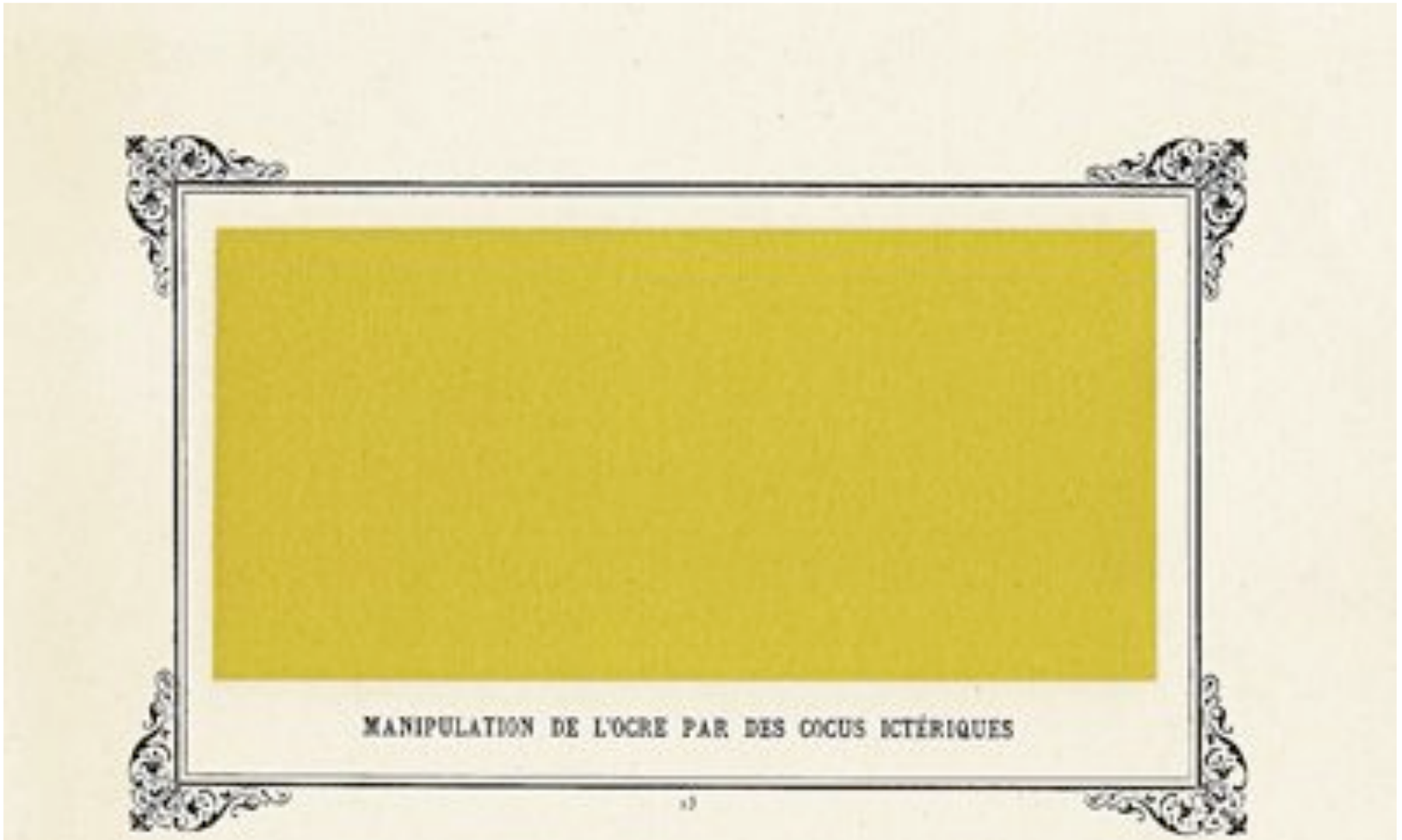

MANIPULATION DE L'OCRE PAR DES OCUS ICTÉRIQUES

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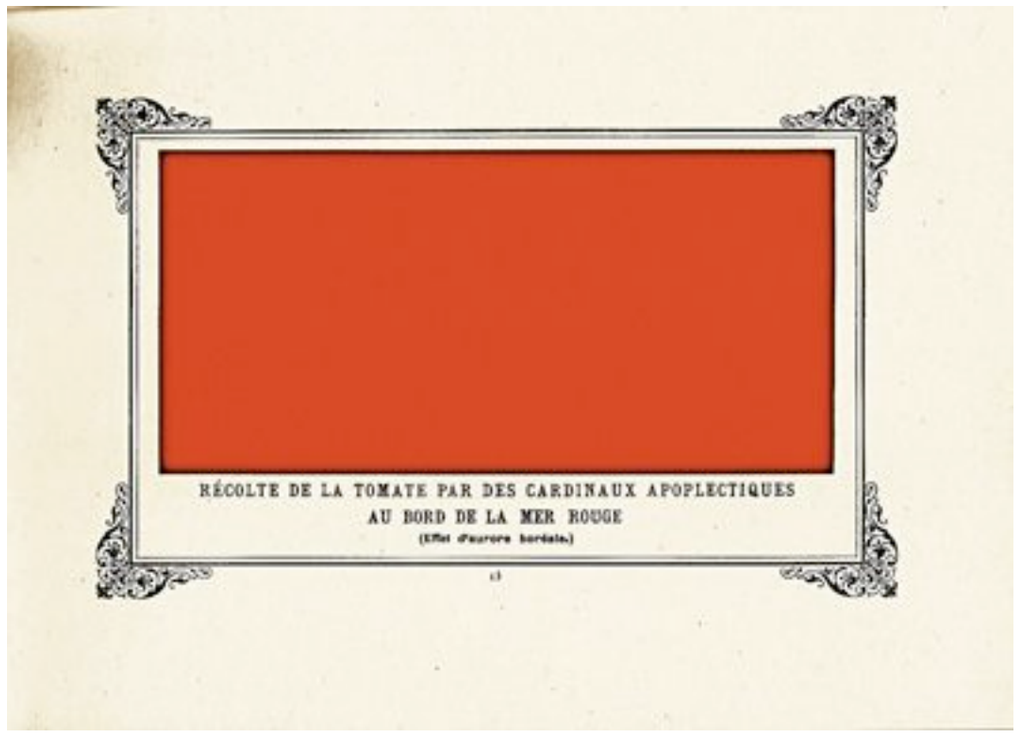

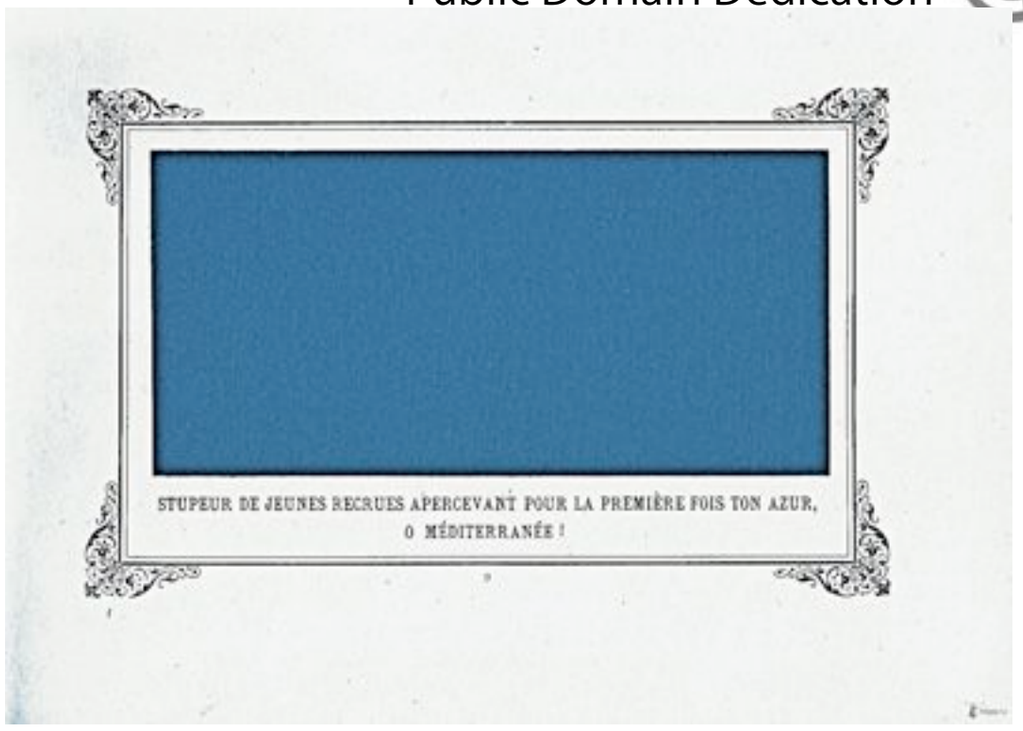

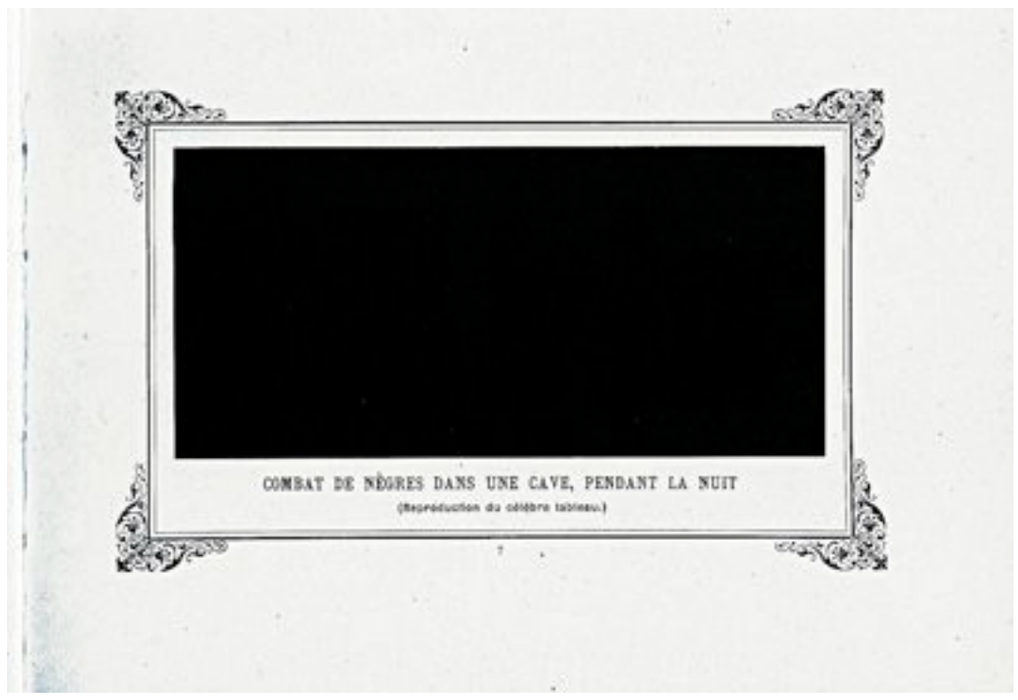

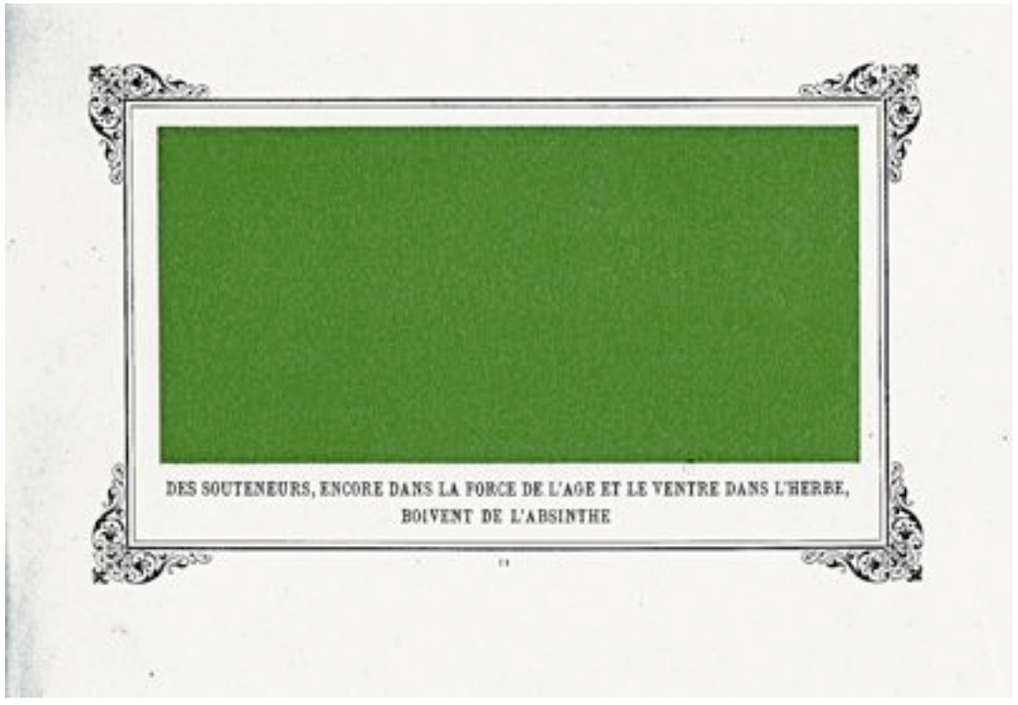

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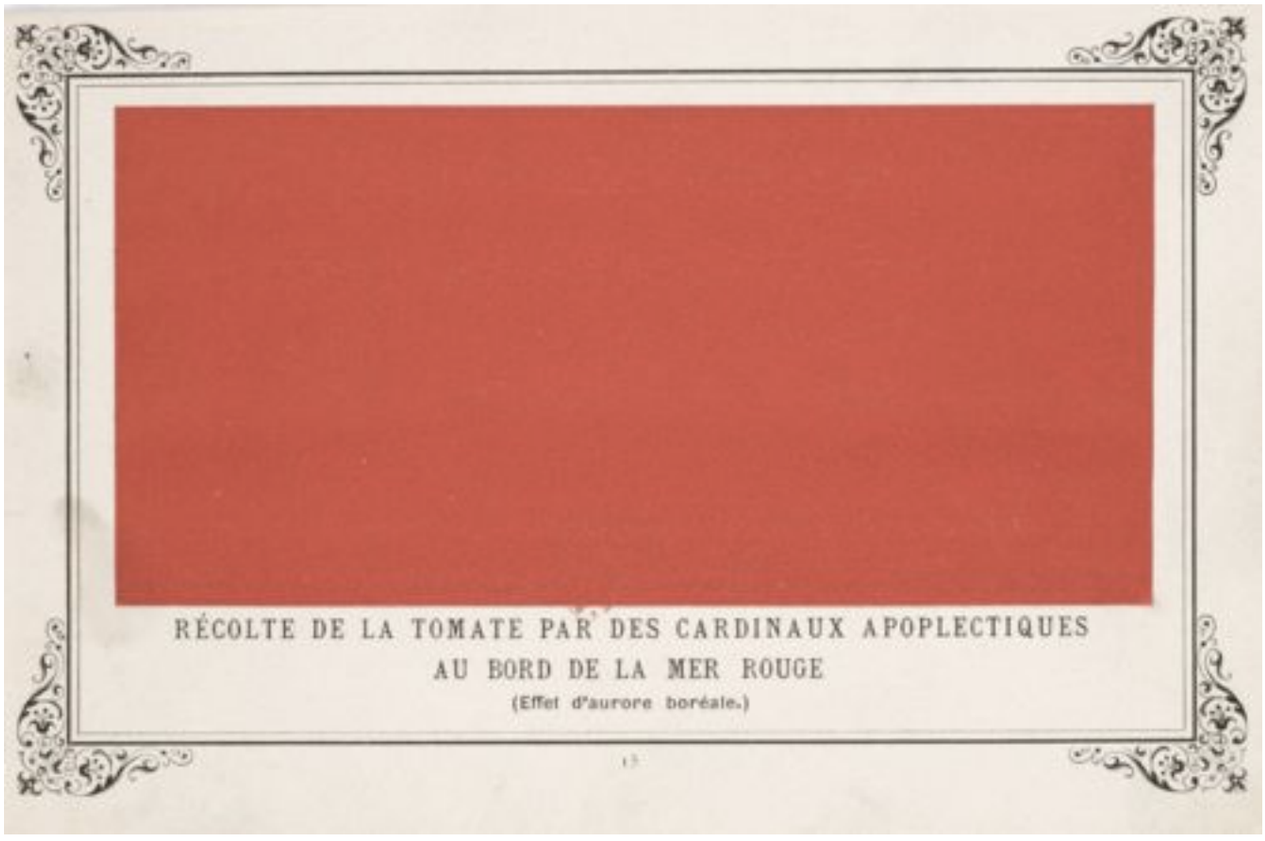

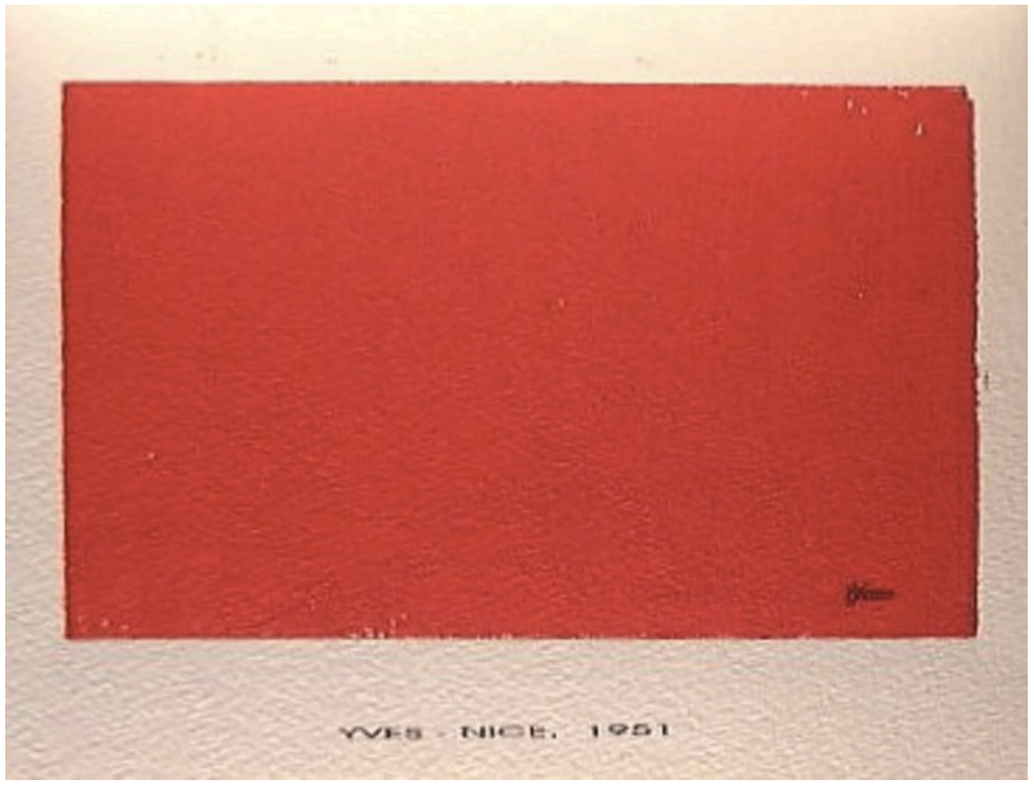

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Ces gens de lettres et de scène ne savent pour la plupart ni dessiner ni peindre, mais ils manient avec adresse l'art des cartels qu'ils truffent de calembours et d'homophonies. Ils excellent également dans l'exposition d'objets quotidiens ou banals transfigurés, telle la succulente « Terre cuite (pomme de) » d'Alphonse Allais en 1883

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Crypto-Myths

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Dogon Cosmology

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Figure 61. The origin of the spiral of creation (indigenous drawing: actual size)

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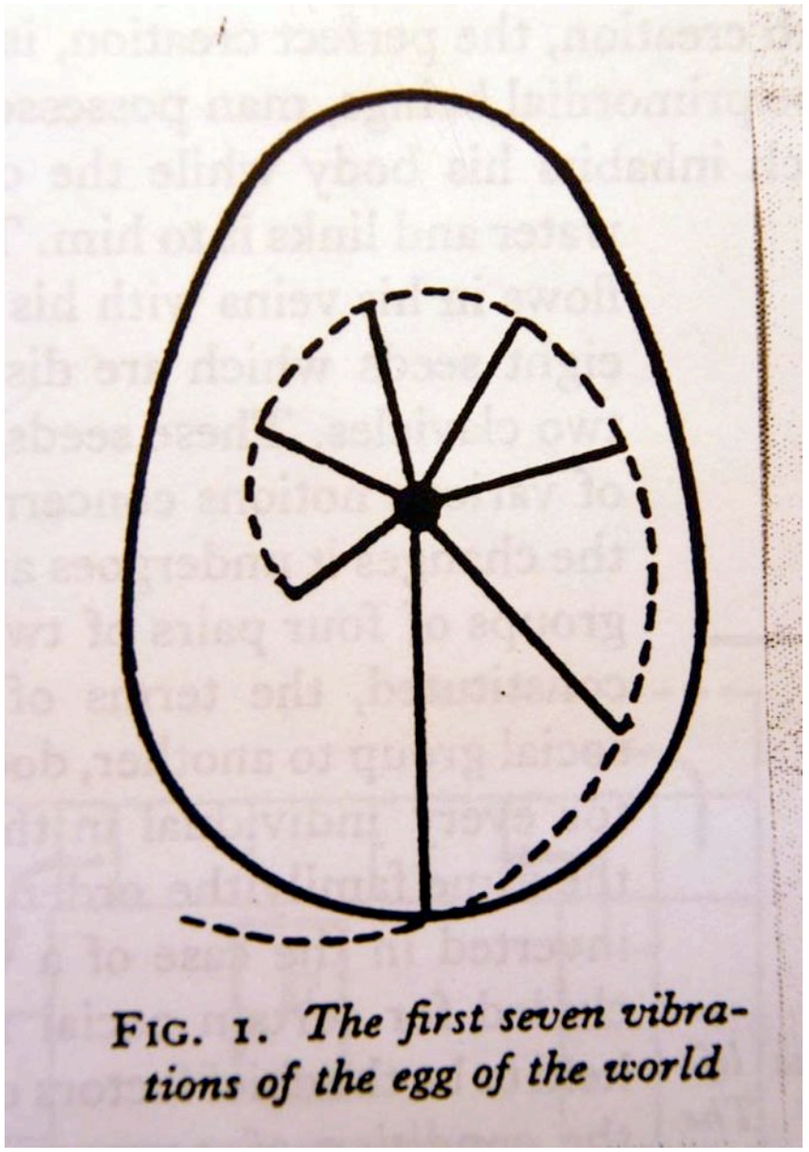

FIG. 1. *The first seven vibrations of the egg of the world*

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14 Layers Dogon Universe

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Monte Verita, Ascona

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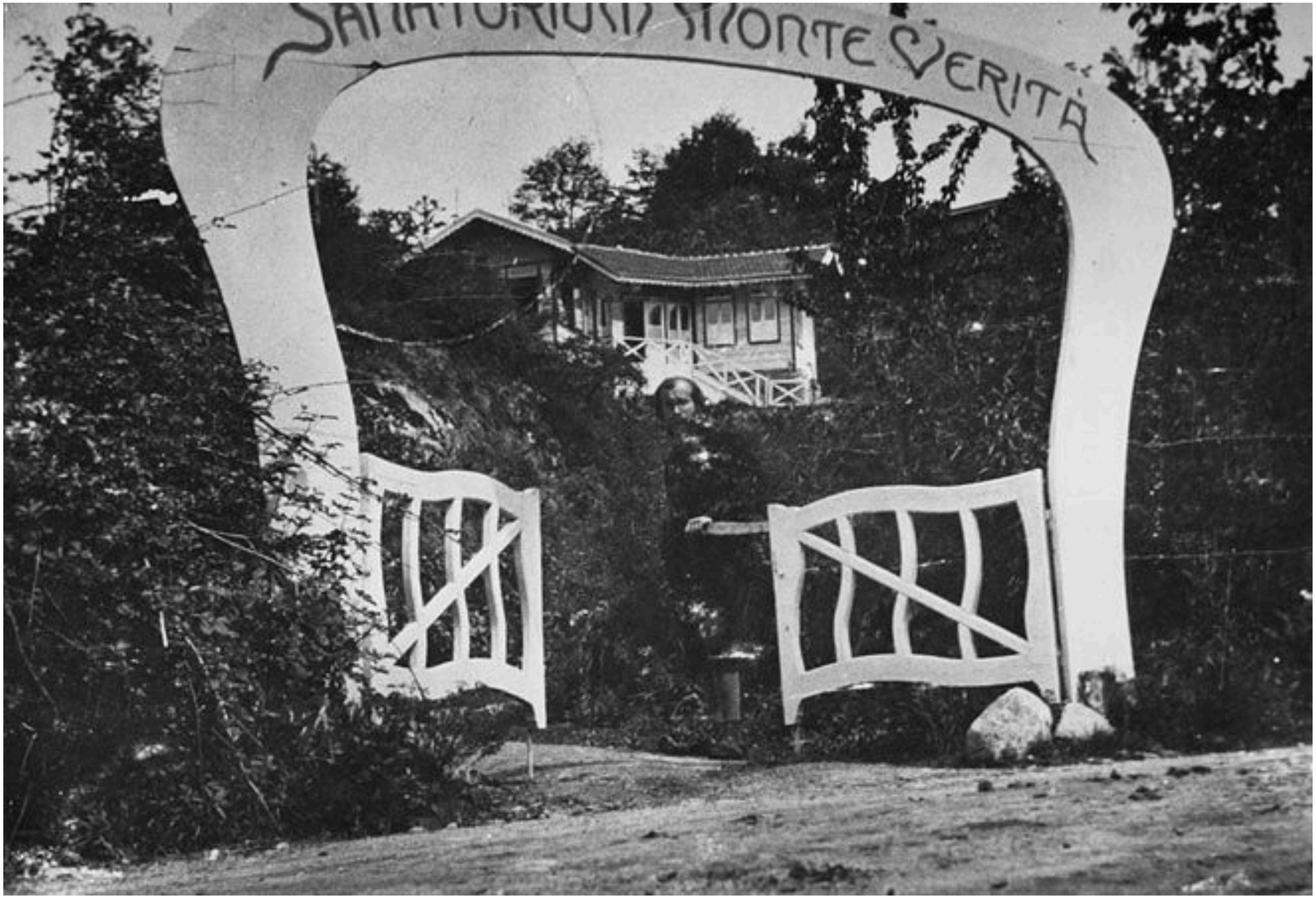

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Monte Verita, Ascona

Anarchist physician Raphael Friedeberg moved to Ascona in 1904, attracting many other anarchists to the area. Artists and other famous people attracted to this hill included Hermann Hesse Carl Jung, Erich Maria Remarque, Hugo Ball, Else Lasker-Schüler,Stefan George, Isadora Duncan, Carl Eugen Keel, Paul Klee, Carlo Mense, Arnold Ehret, Rudolf Steiner, Mary Wigman, Max Picard,Ernst Toller, Henry van de Velde, Fanny zu Reventlow, Rudolf von Laban, Frieda and Else von Richthofen, Otto Gross, Erich Mühsam,Karl Wilhelm Diefenbach, Walter Segal, Max Weber, Gustav Stresemann and Gustav Nagel....

From 1913 to 1918, Rudolf Laban operated a "School for Art" on Monte Verità, and in 1917Theodor Reuss, Master of the Ordo Templi Orientis organized a conference there covering many themes, including societies without nationalism, women's rights, mystic freemasonry, and dance as art, ritual and religion

http://en.wikipedia.org/wiki/Monte_Verit%C3%A0

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Anarcho-Naturism

LebensReform

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WALDEN;

OR,

LIFE IN THE WOODS.

By HENRY D. THOREAU,

AUTHOR OF "A WEEK ON THE CONCORD AND MERRIMACK RIVERS."

I do not propose to write an ode to dejection, but to brag as lustily as chanticleer in the morning, standing on his roost, if only to wake my neighbors up. — Page 92.

BOSTON:
TICKNOR AND FIELDS.
M DCCC LIV.

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Arm- und Handstudien

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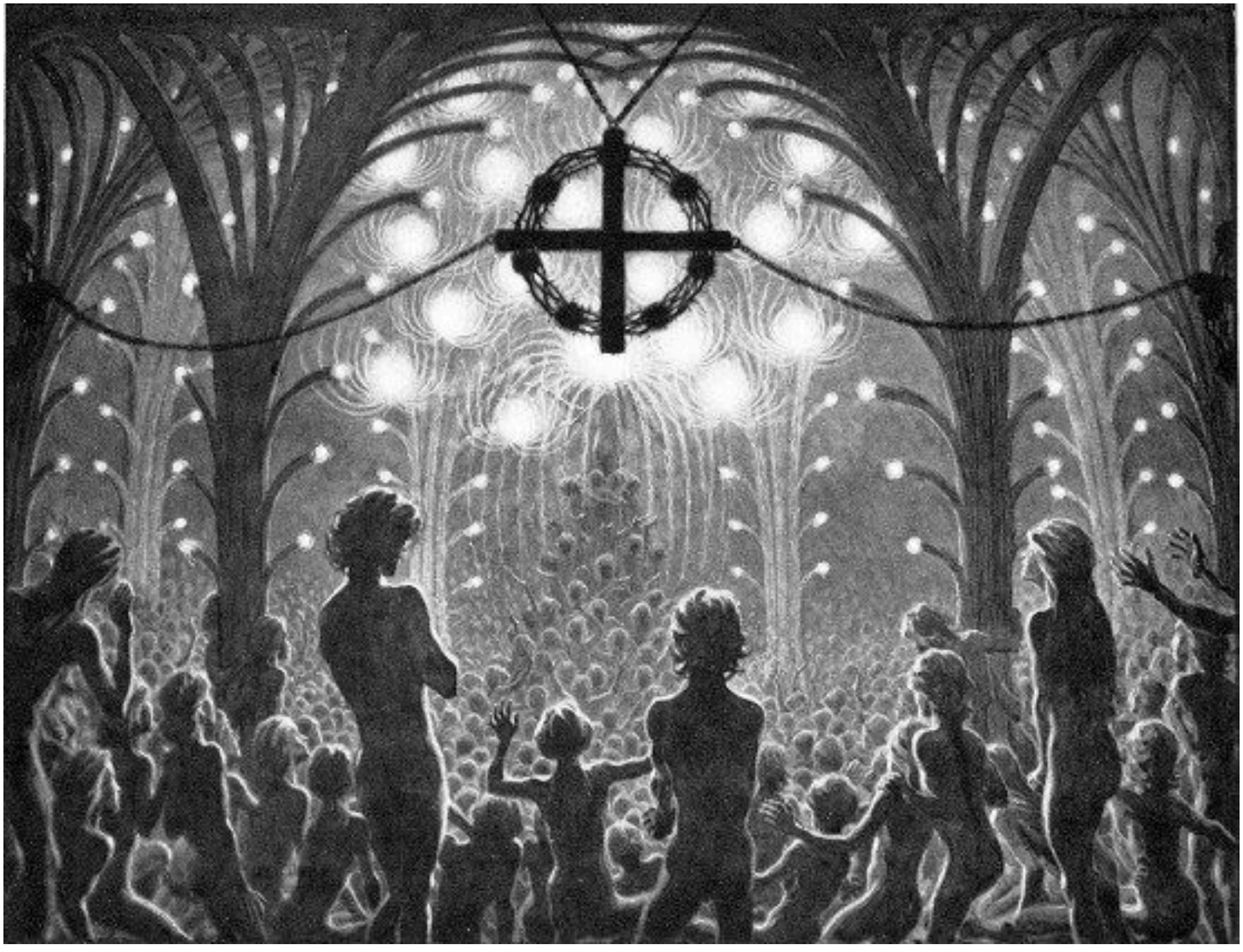

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Eranos, Ascona

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Mary Wagman, Dancer

Max Bill, Architect

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Meaning of Eranos

The word 'Eranos', in Greek language, applies to a banquet, both spiritual and material, which lasts thanks to the contributions each participant makes. The Hungarian mythologist **Karl Kerenyi** took the original meaning of the word, which appears for the first time in Greek literature in Homer's Odyssey, in terms of a 'spiritual nucleus': this was to be developed by participants in an atmosphere of freedom and spontaneity, with songs, poems, improvised verses, or with a symbolical offering to the group.

From 1933 onwards, a modern Eranos took place again and lasted for more than seventy years at Ascona-Moscia, on the Swiss side of Lago Maggiore. It was there that **Olga Fröbe Kapteyn**'s idea to create a 'free space for the spirit', a 'meeting place between East and West' took shape, and where the relation between the individual, the spirit and the peculiar images of the soul were to be unceasingly re-imagined.

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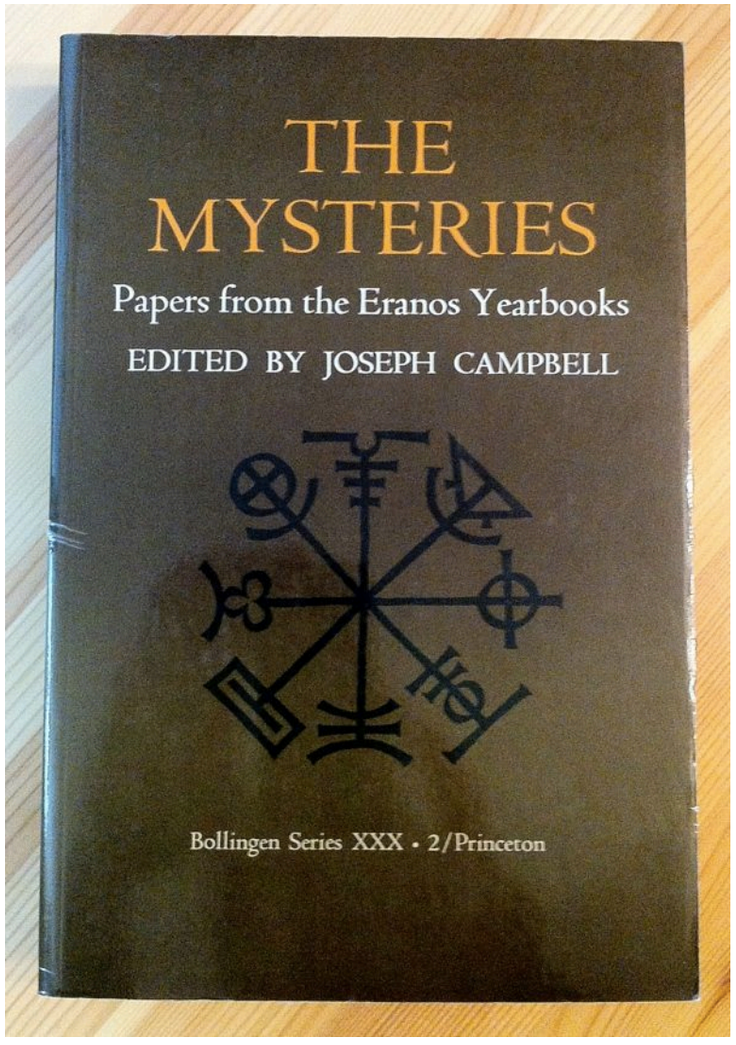

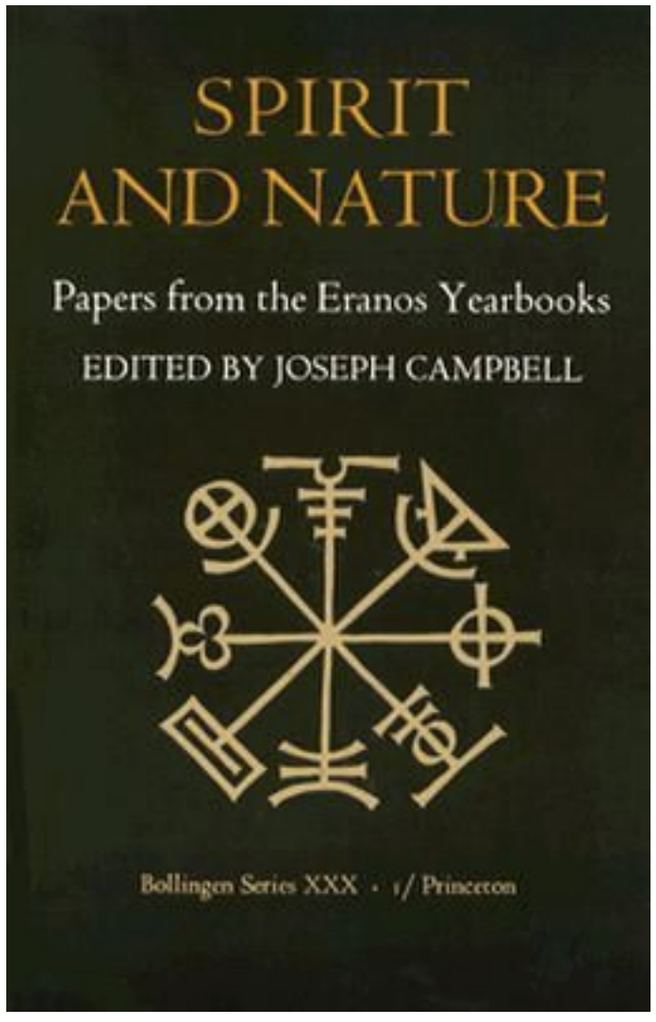

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"Although changed, I arise the same"

http://en.wikipedia.org/wiki/Eadem_mutata_resurgo

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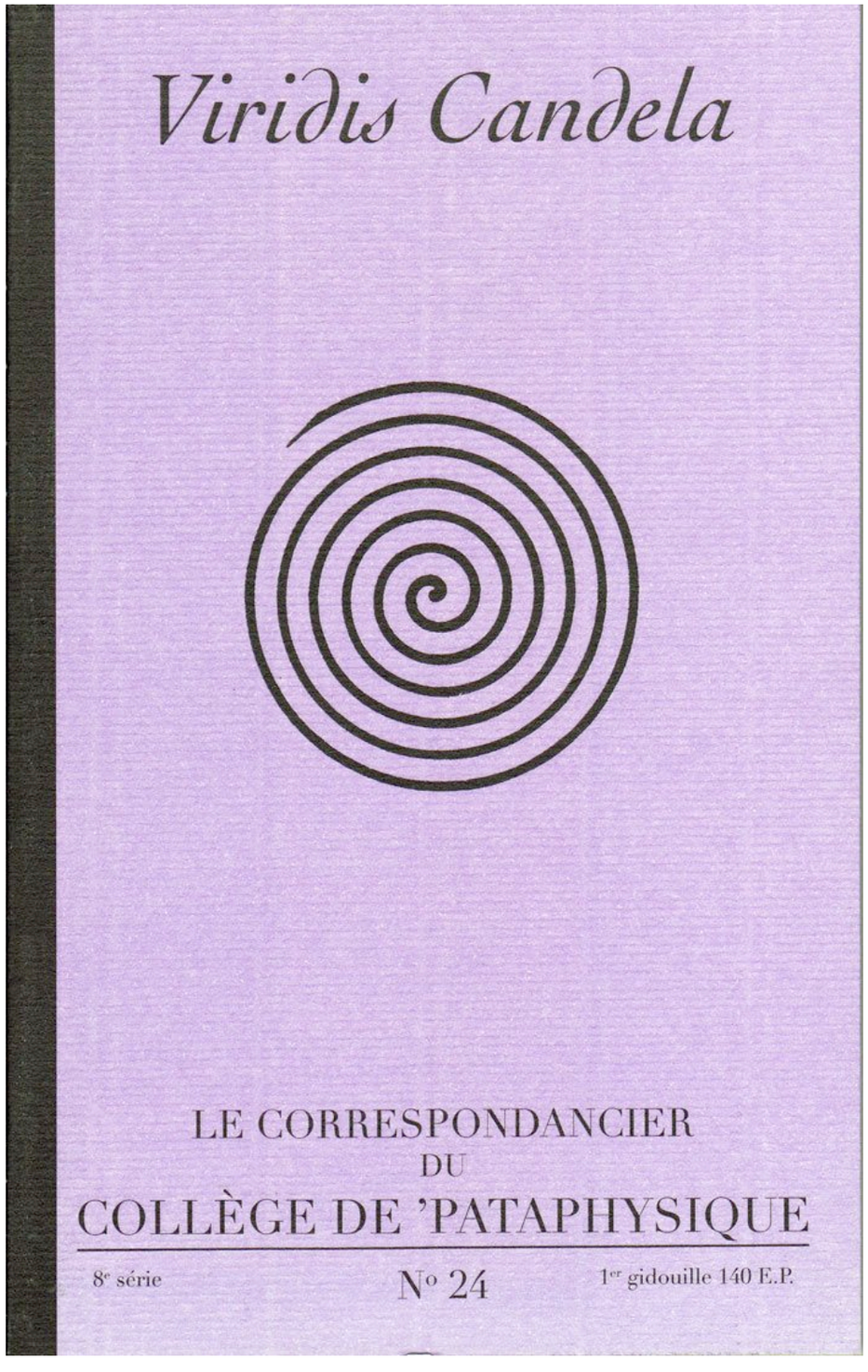

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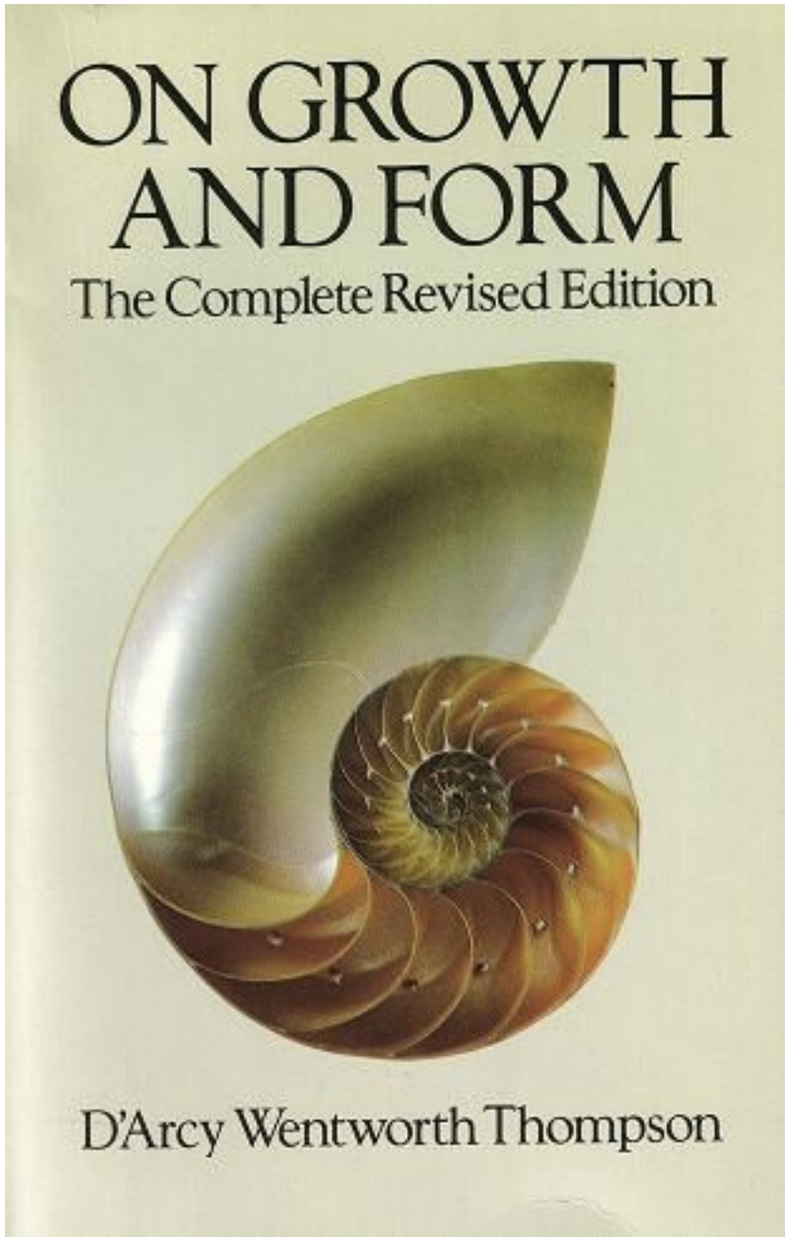

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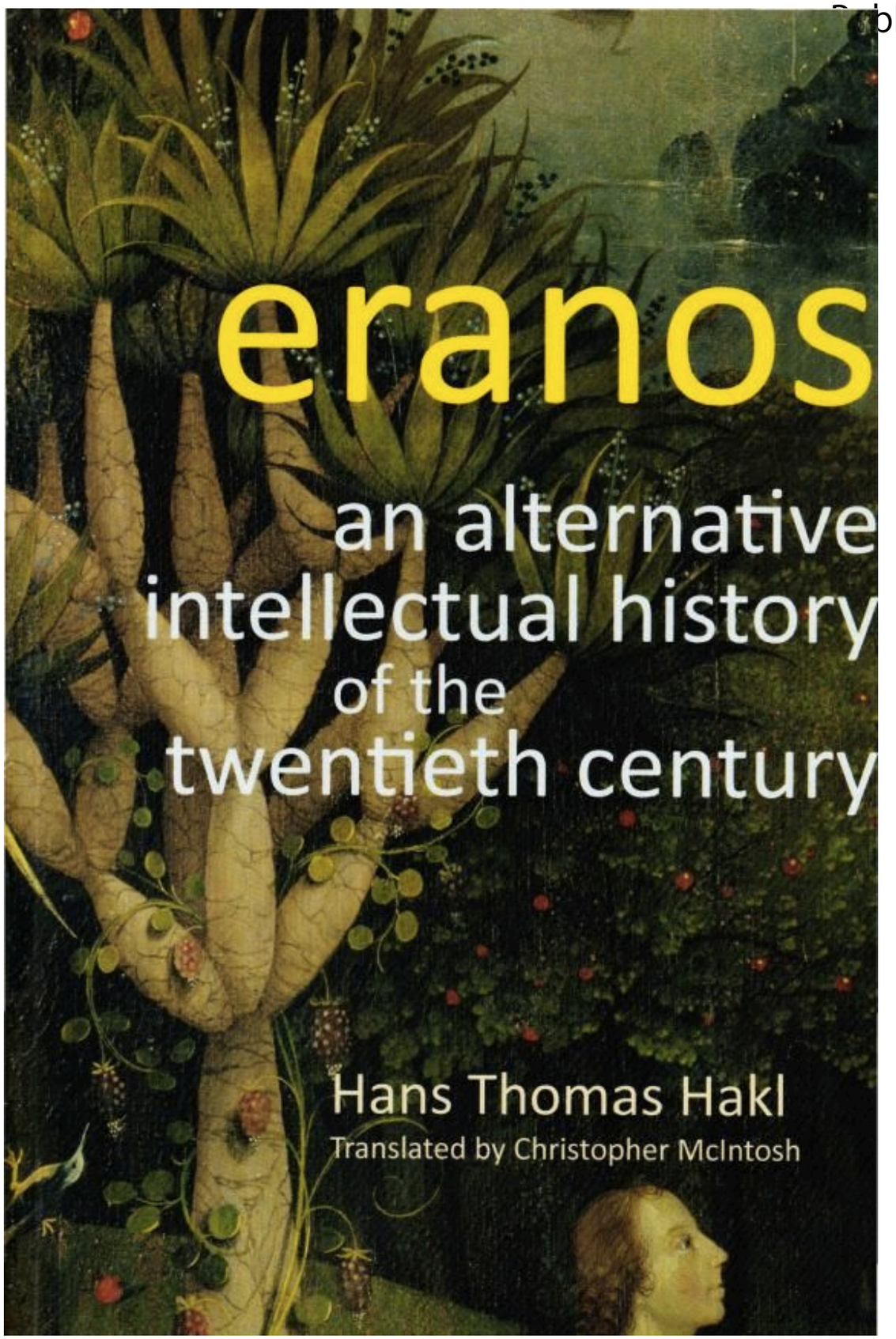

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Attar Birds Cantics

Eranos Foundation

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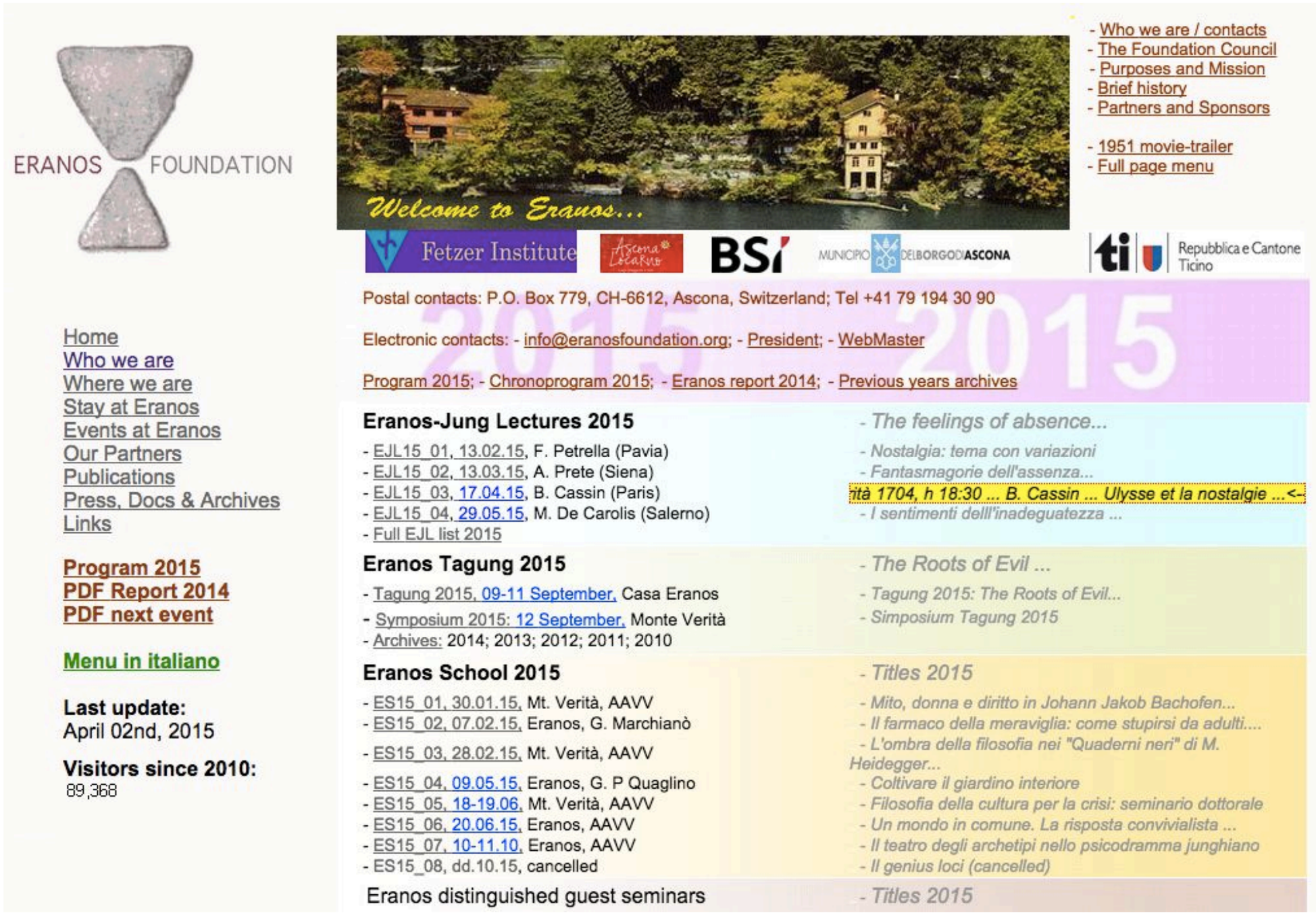

http://en.wikipedia.org/wiki/Rudolf_Ritsema
http://www.eranosfoundation.org/

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Discordianism

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Robert Anton Wilson

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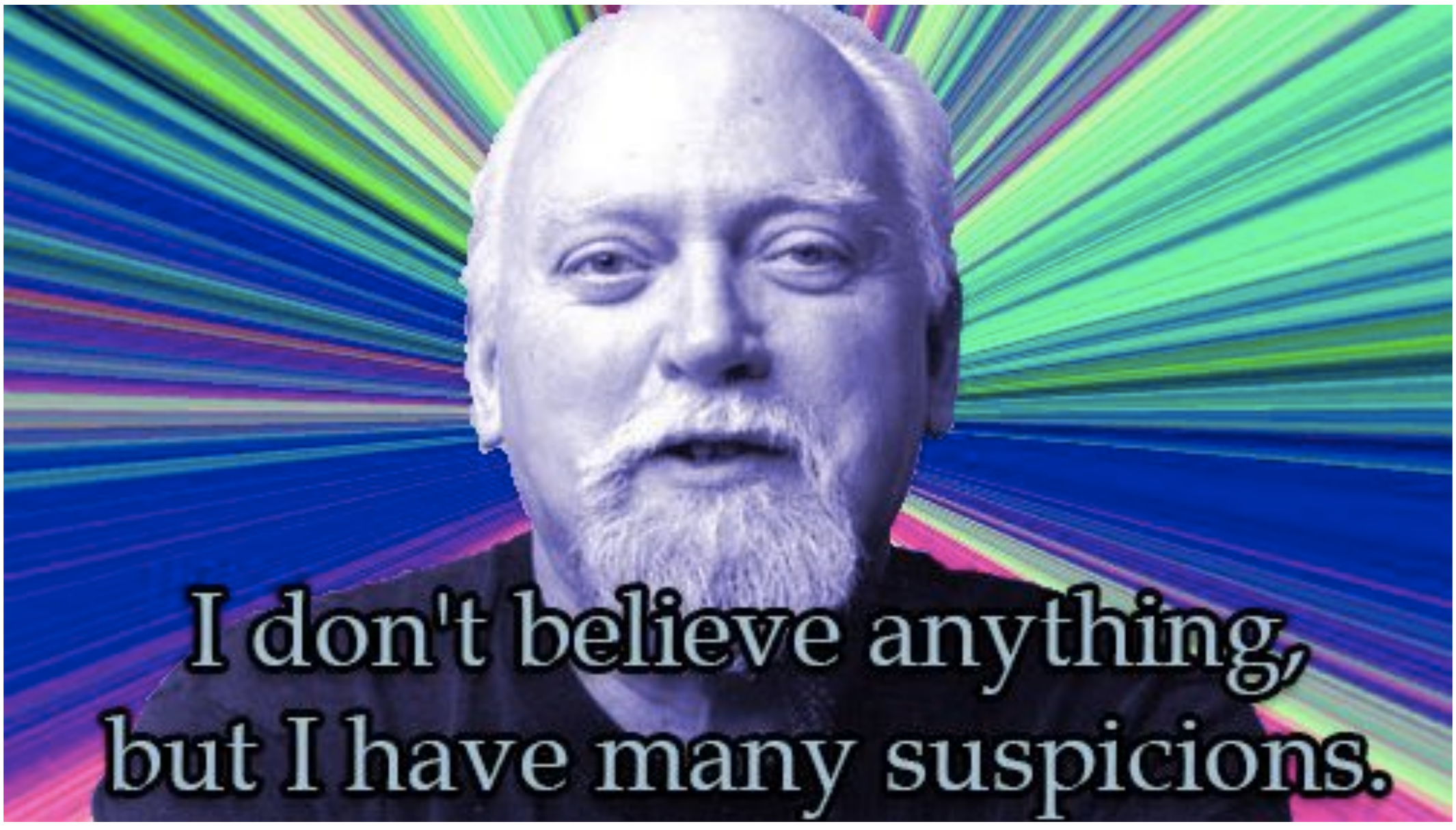

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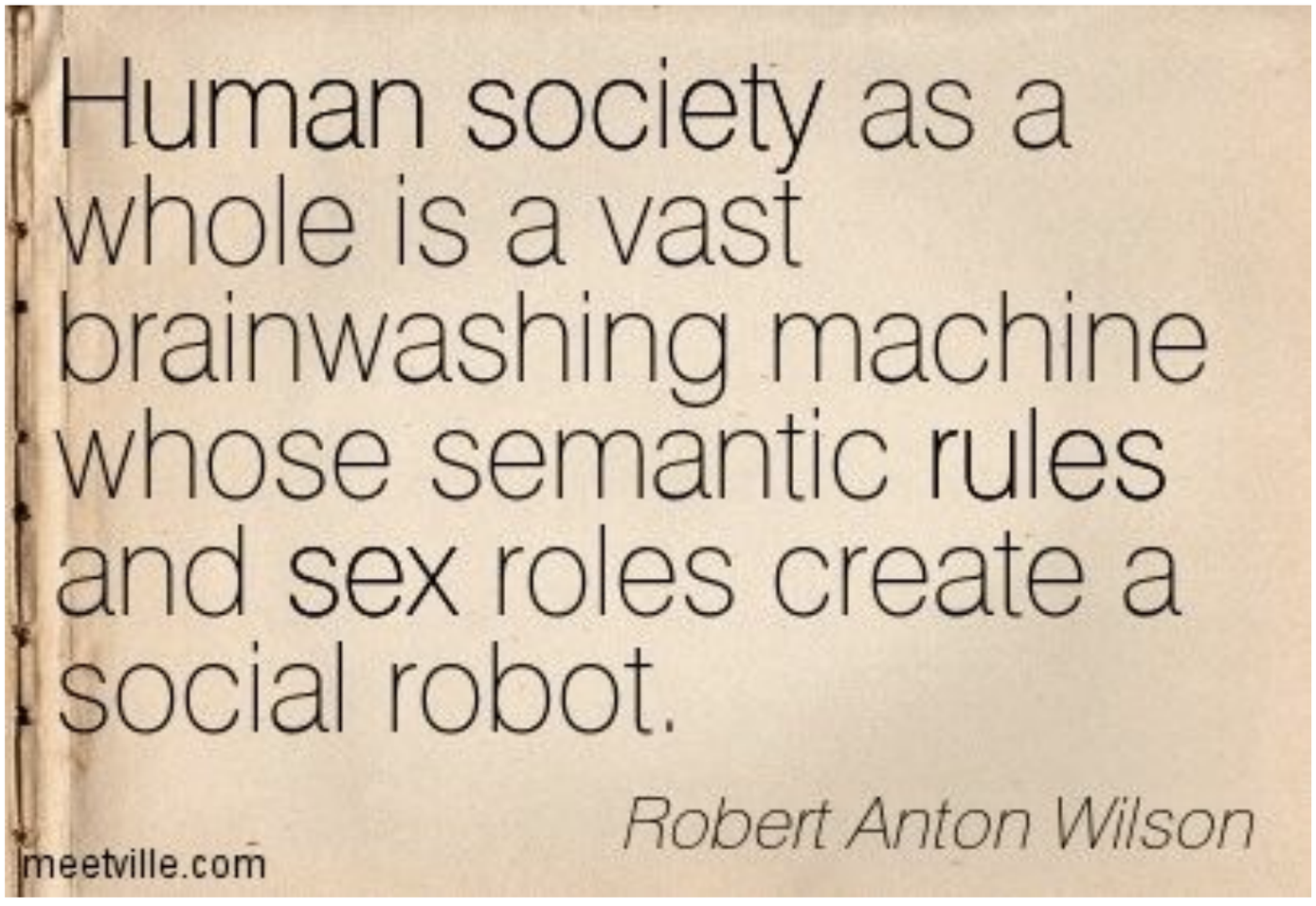

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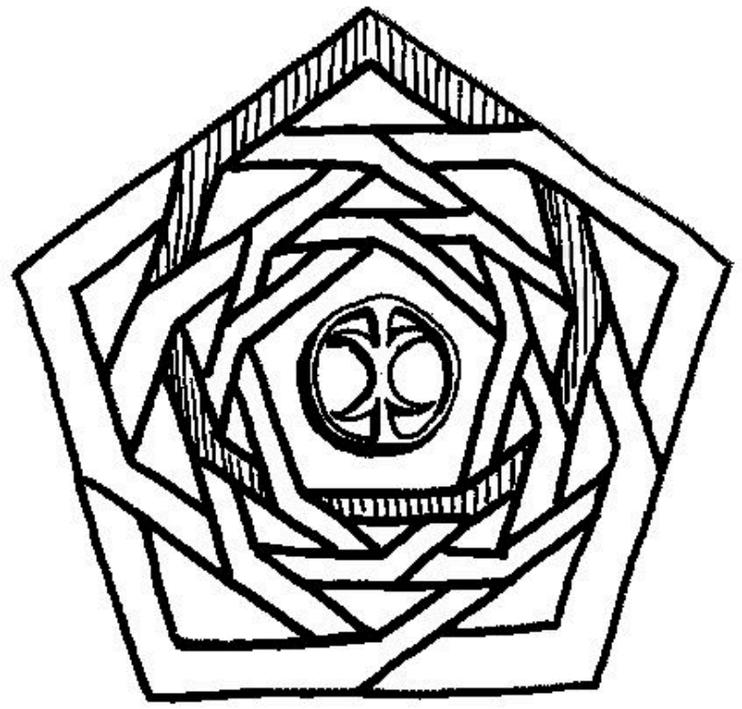
MAP LIBRARY
MAP LIBRARY

Climb into the Sea with a friend or two
And follow the Way it surprises you.
Adrift like a Lunatic Lifeboat Crew
Over the Waves in whatever you do.
(NBT, The Book of Advice, 1:3)

MANDALA



NO TWO ELEMENTS INTERLOCK
BUT ALL FIVE DO INTERLOCK

00043

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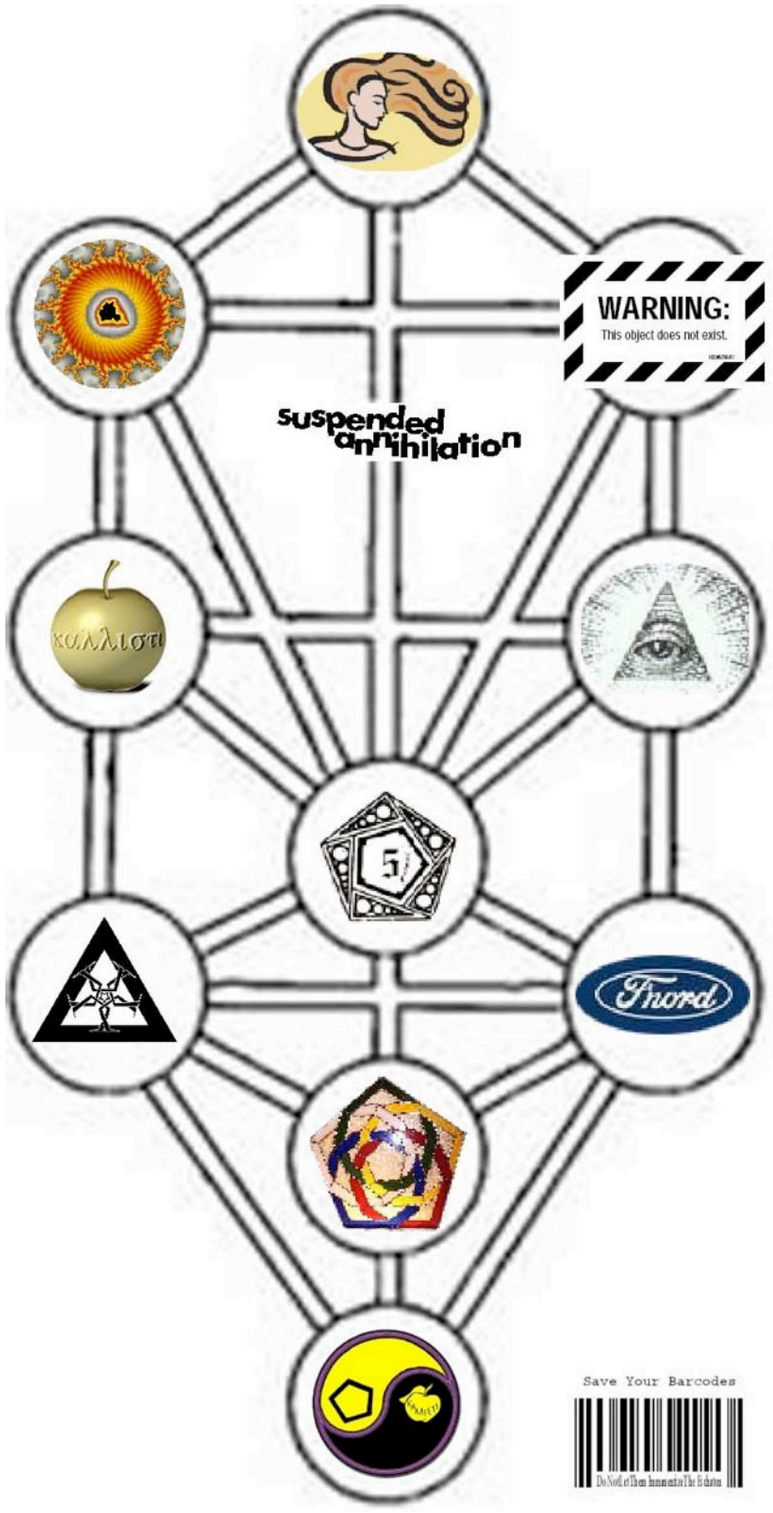

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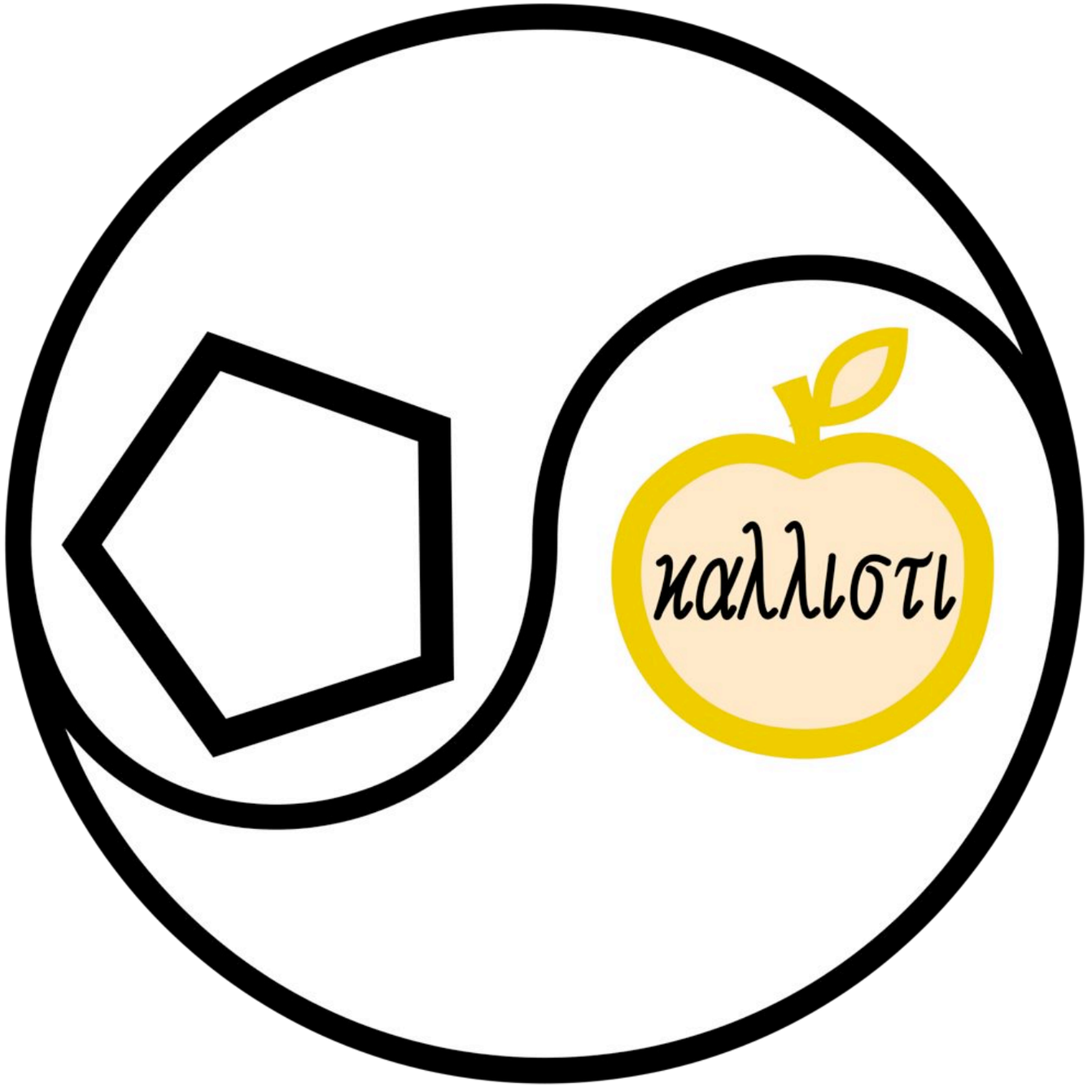

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PRINCIPIA DISCORDIA

• OR •

How I Found Goddess
And What I Did To Her
When I Found Her

THE MAGNUM OPIATE OF MALACLYPSE THE YOUNGER

WHEREIN IS EXPLAINED
ABSOLUTELY EVERYTHING WORTH KNOWING
ABOUT ABSOLUTELY ANYTHING

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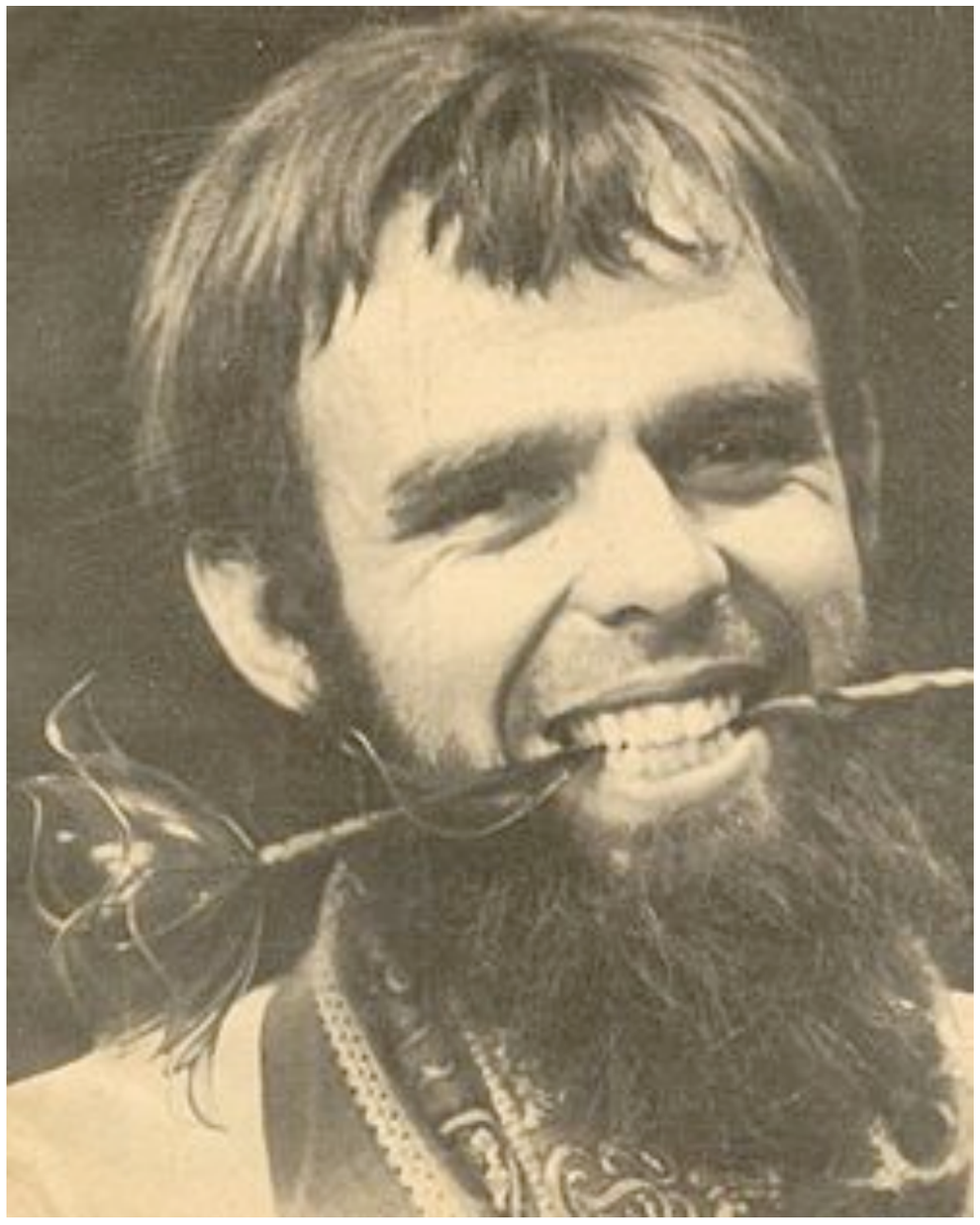

Kerry Wendell Thornley

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CC0 1.0 Universal (CC0 1.0)
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ORDO AB CHAO

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DISCORDIANISM : A GRAPHIC ARTICLE

A religion disguised as a joke, or a joke disguised as a religion : this is the spirit of discordianism, a religious movement borned in the United States during the late 50's. With absurd and humour, Discordians preach the virtues of chaos and creation to fight the sterile order. Mythology, conspiracy theories, eastern philosophy, prank and anti-establishment spirit mingle and create a blur between reality and dream. Everything is true. Everything is false. Or not.

CHURCH

LORD OMAR

Aka Kerry Wendell Thornley (1938-1998). Came from a mormon familly, he published underground newspapers on its own. One of them was devoted to zenarchism, a form of buddhist anarchism which rejects the research of a stable state of mind. During a bowling game, around 1958, he had a revelation and created, with **Malaclypse the Younger**, discordianism.

POPE

Highest degree in dischordian hierarchy. According to **Principia Discordia,** every man, woman and children on earth is a pope. You can print yourself a pope card which allow you several rights. Such as invoking infallibility at any time, including retroactively, the possibility of reworking discordian dogmas and appointing someone else pope, or even canonise a **saint**.

SAINTS

Every discordian **pope** is able to canonise a person who proved to be worthy of **Eris.** Among them : Don Quixote, fictional character created by Cervantes, Joshua Norton (drawing) who proclaimed himself emperor of the United States in 1858, and Ed Wood, who is considered to be the worst film director of all time.

MALACLYPSE THE YOUNGER

A k a Gregory H i l l (1941-200). Sent by **Eris** to **L o r d Omar**, he will help him write the **Principia Discordia**. The character appears also in the **Illuminati!** trilogy, in which is the founder of the Norton Cabal.

ROBERT ANTON WILSON

Writer, psychologist and poet (1932-2007). Advocator, with the guru of LSD Timothy Leary, of the eight circuits model of consciousness. He became famous with the trilogy **Illuminati!**, co-written with Robert Shea, which combine discordian mythology and conspiracy theories. Foucault's Pendulum by Umberto Ecco and Da Vinci Code by Dan Brown owe him a great debt.

DOGMA

THE CURSE OF GREYFACE

In 1166 BC, Greyface convinces men that life is a serious thing. Order is seen as positive and disorder as negative. Play is a sin because it goes against order, serious, which had to be prefered at all costs. Discordianism fights against this idea of negative-positive and prefers the destruction-creation one. And so it chooses creation at all costs.

HOT-DOG

After throwing the golden apple, **Eris** joyously partook of a hot dog. Since, every Discordian has to do so every friday, like Christians with fish, without eating it with a hot dog bun. But he can eat it if he wants to as well.

ERIS

Greek goddess of strife and discord and main figure of the religion. Enraged because she hasn't been invited to Peleus and Thetis wedding, she tossed in the party a golden apple inscribed Kallisti (For the most beautiful one). This apple will be offered by Päris to Aphrodite, in exchange for the love of Helen of Troy, and will provoke the first great conflict between men : the Trojan War.

THE SACRED CHAO

Discordian symbol, inspired by the taoist Yin-Yang. It illustrates the interrelation between order and disorder. The pentagon acts for apparent order. The apple for apparent disorder. They are both artificial divisions, created by man in order to describe the univers, which is pure chaos.

PRINCIPIA DISCORDIA

The Discordian Bible, co-written by **Lord Omar** and **Malaclypse the Younger.** Between 1963 and 1969, more than 3000 copies will be published and the book became a cult object in the undergound culture. The text has been modified several times, according to the authors' wishes, an republished on paper or digital format. On Internet, the whole book is easily available on consultation.

THE LAW OF FIVE

"All things happen in fives, or are divisible by or are multiples of five, or are somehow directly or indirectly appropriate to five", according to the **Principia Discordia**. A weird joke on the surface which shows, more seriously, that our perception of reality is conditioned by the grid we used to see the world ("All is linked to five"). The 23 enigma, belief in the fact that all is related to the number 23, is the absurd corollary of the law of five.

CONSPIRACY

JOHN FITZGERALD KENNEDY

In 1958, Kerry Thornley (**Lord Omar**) is summoned to active duty in the Marines Corps. He met there a soldier, Lee Harvey Oswald, and used it as a fictional character in a book published in 1962, a year before Oswald became the main suspect in the Kennedy's assassination. Due to this coincidence, Thornley was called to testify before the Warren Commision, which worked on JFK's death. According to Thornley, he met in the Marine Corps two CIA agents who, during conversations, predicted Nixon's accession to the presidency and the rise of the 60's counterculture. With all these consistent informations, reality hard to verify though, Thornley will became increasingly paranoid and distrustful.

THE ILLUMINATI

The Illuminaty were first a german secret society, created in 1776, and influenced by the Age of Enlightenment. Just as freemasonry, conspiracy theories will bound to it and **Robert Anton Wilson** will use them in his book Illuminati!. They become a secret organisation, fought by Discordians, controling governments in the purpose to establish a new world order. Main symbol of their presence : the eye ornated pyramidion on the US dollar.

PRANK

THE MERRY PRANKSTERS

Formed around author Ken Kesey (One Flew Over the Cuckoo's Nest), the group ridged across the United States in 1964 on a school bus. Using psychedelic drugs and pranks, they were one of the biggest inspiration of hippie movement. The Electric Kool-Aid Acid Test by Tom Wolfe tells tales of this adventure.

OPERATION MINDFUCK

Essential practice for Discordians. Developed by **Kerry Thornley** and **Robert Anton Wilson** in 1968, it's manifested by a decentralized campaign of civil disobedience, activism, performance art, practical jokes, chaos magic and trolling. The aim of Operation Mindfuck is to force the victim to question his own vision of reality.

THE YES MEN

Culture jamming activist duo created by Jacques Servin and Igor Vamos. Impersonating World Trade Organisation participants, they hold forth on the possibility to sell one's vote, advocating of slavery or recycling human waste in order to feed the poor. Two films documenting their work are available : The Yes Men (2003) and The Yes Men Fix the World.

WEBSITES

- **www.discordian.com**
Display of the religion
- **principiadiscordia.com**
The single text online

RELATED RELIGIONS

THELEMA

Spiritual philosophy established by writer and occultist Aleister Crowley at the beginning of the twentieth century. Based on the motto "Do what thou wilt", inspired by the François Rabelais's book Gargantua. Crowley claims that he took dictation from an entity during a wedding trip in Egypt. The combination of occult, eastern and western mysticism will be an inspiration, with much more humor, to discordianism.

CHURCH OF THE SUBGENIUS

Parodic church created in 1979, Texas. Coming from undergound circles, it develops its cult especially on Internet, with for instance Slackware, one of the oldest Linux-based operating system, which pay tribute to the church. Its followers devote themself to Jr "Bob" Dobbs, considered to be the best salesman of all time, who talked to god through his home-made TV-set. The church has such famous members as comics writers Robert Crumb and Warren Ellis or bands like Devo and Gwar.

PASTAFARIANISM

Mock religion created in 2005 by Bobby Henderson, physics graduate, in order to protest against the teaching of intelligent design as an alternative to evolution in Kansas public school sciences classes. In an open letter, he modernises the Russel's teapot analogy and profess his belief in a creator which looks like to a monster made of spaghetti and meatballs. And so he asks pastafarianism to be allotted equal time in science classrooms alongside intelligent design and evolution.

LEXICON

FNORD

Nonsensical term taken from the **Principia Discordia** and used by **Robert Anton Wilson** in the **Illuminati!** trilogy. The word is scattered in the text of newspapers, books and magazines by the Illuminati in order to cause fear and anxiety and prevent rational consideration. To see the Fnords is to be able to read between the lines, like John Nada with his sunglasses in the John Carpenter's movie They Live !.

PINEAL GLAND

Part of the brain allowing Discordian to communicate with Eris. René Descartes called it the "principal seat of the soul" and believed that it was the point of connection between the intellect and the body. In yoga, it's associated to Ajna chakra, or third eye. According to some scientific researches, this gland is able to produce Dimethyeltriptamine (DMT), a strong psychedelic compound.

MU

The correct answer to a question based on false asumptions. For example, to the question "Did you stop beating your wife", answering "yes" means that you were doing it and "no" that you continue to do it. The correct answer is therefore "Mu". This term, which means "nothing", "non-existent", in zen philosophy, is used in a **Principia Discordia**'s parabol, pun based on the similarity with "to moo".

Texts and drawings : Gwen
Website : www.centrifugue.fr

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Wu Ming

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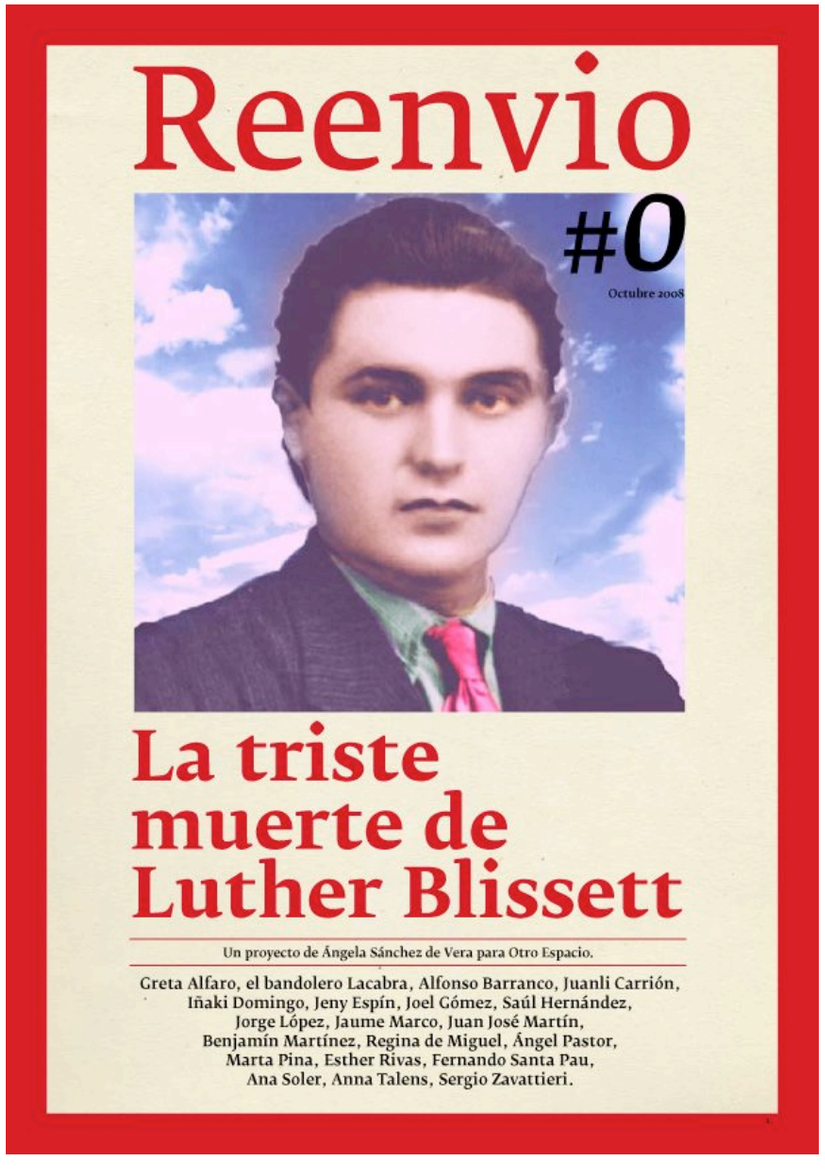

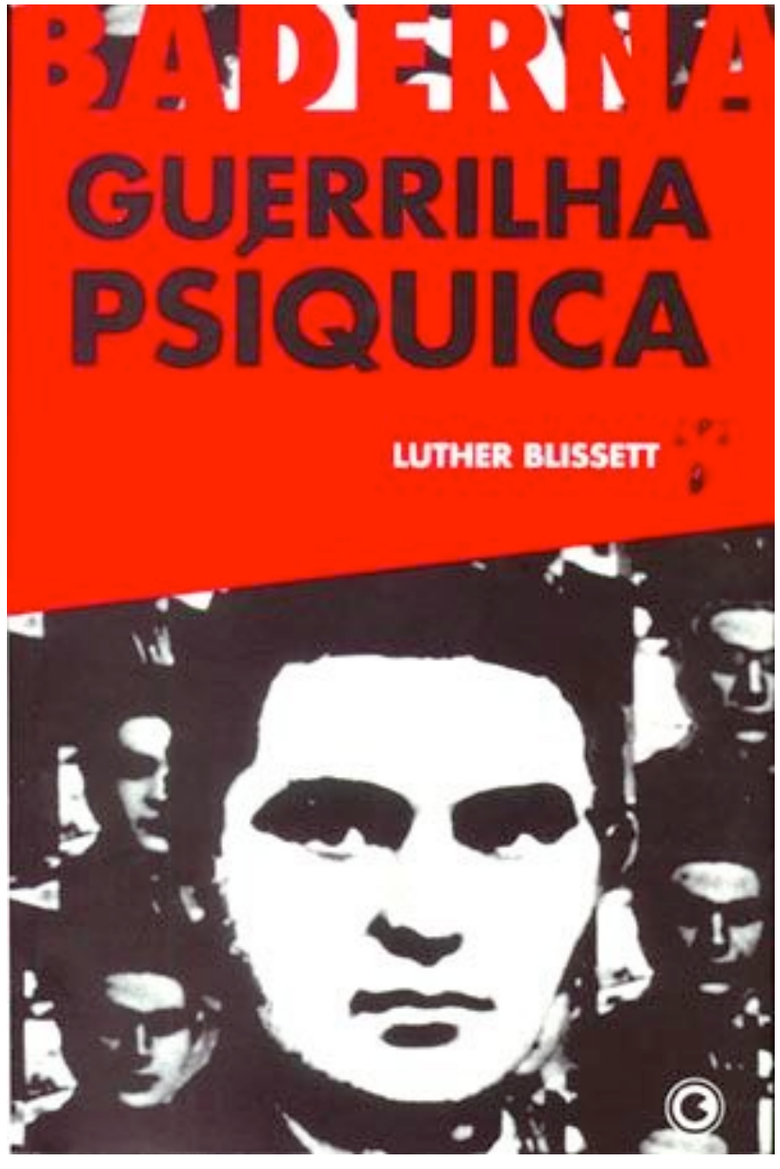

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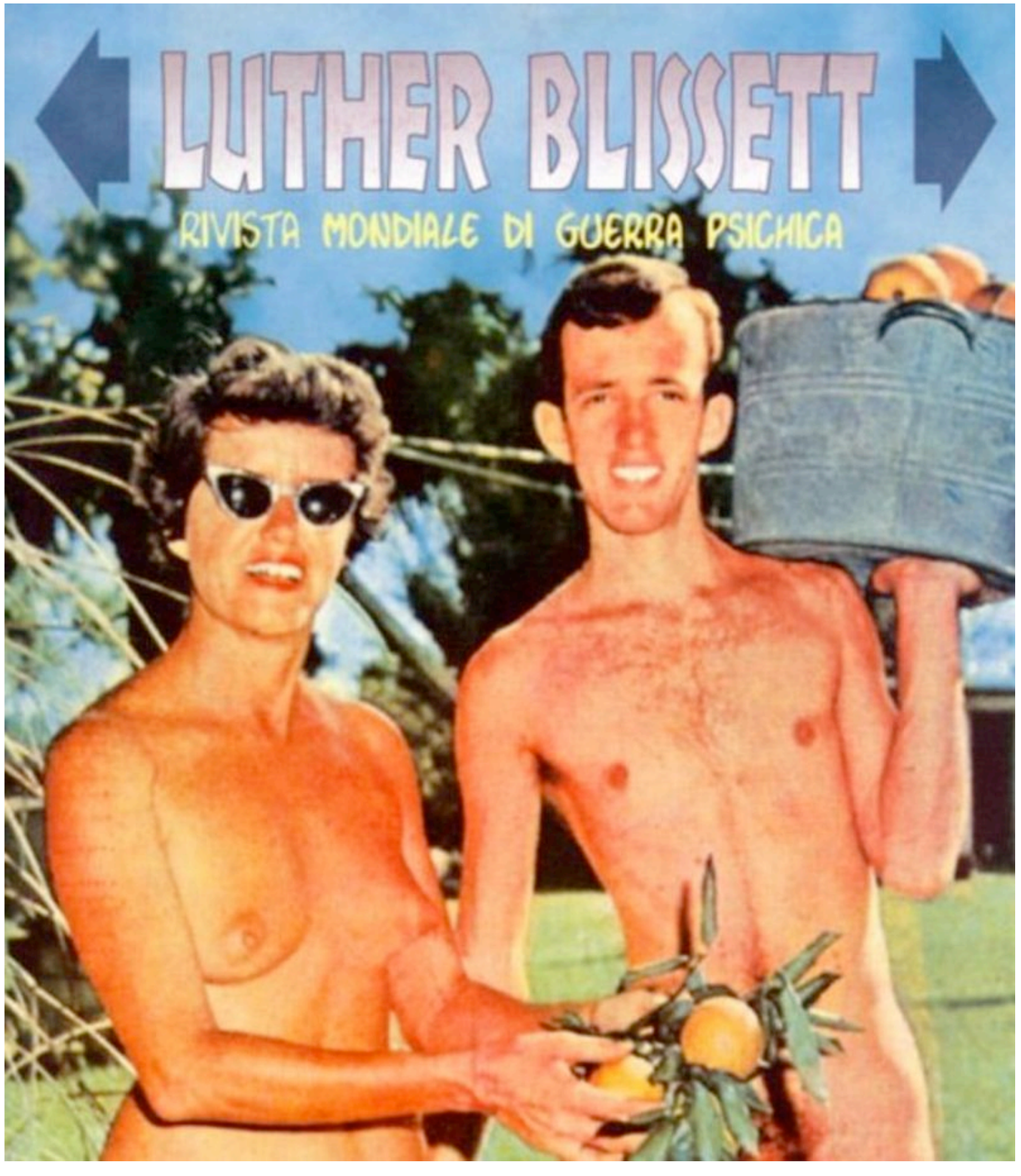

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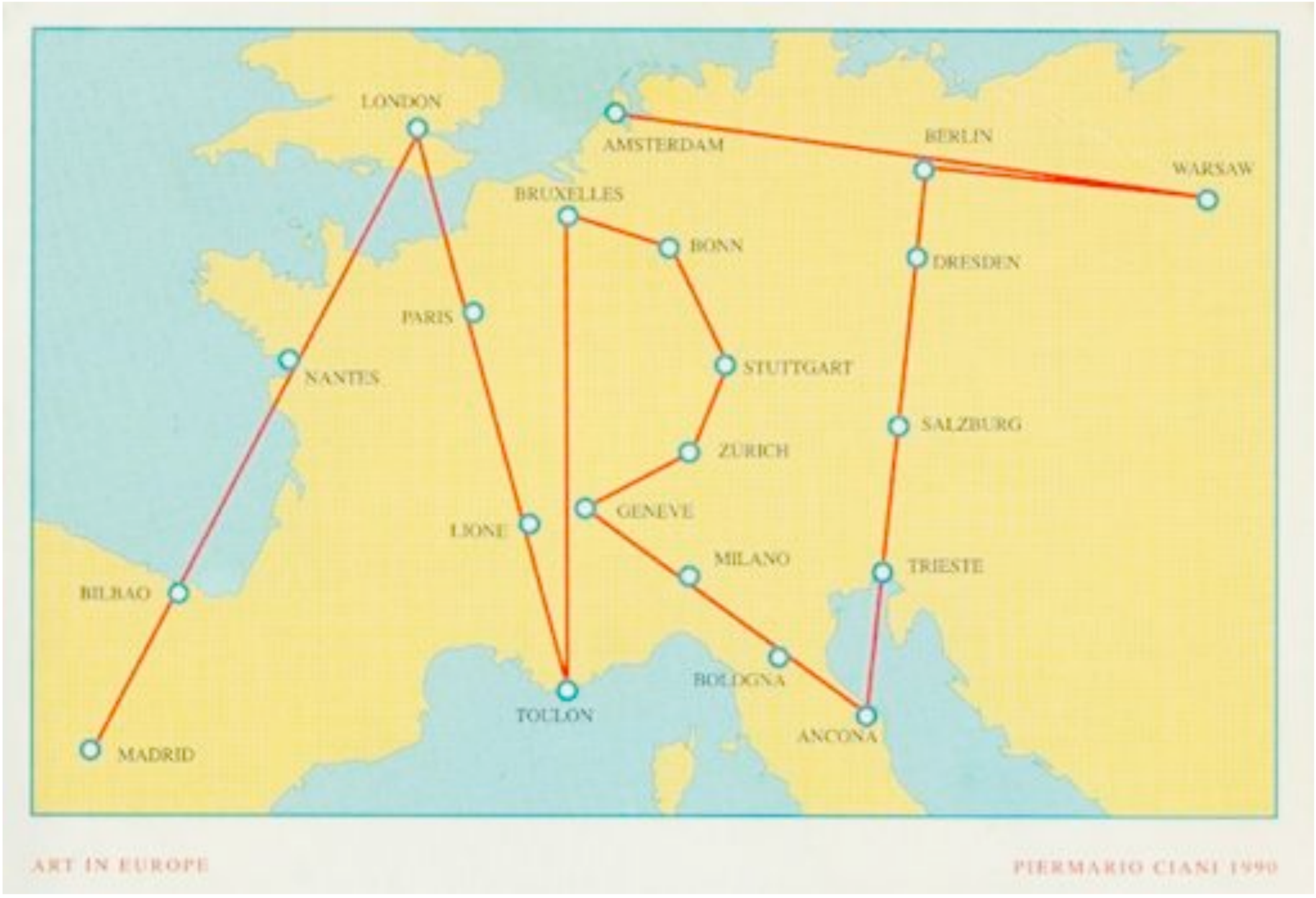

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Cybernetics

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FeedBack

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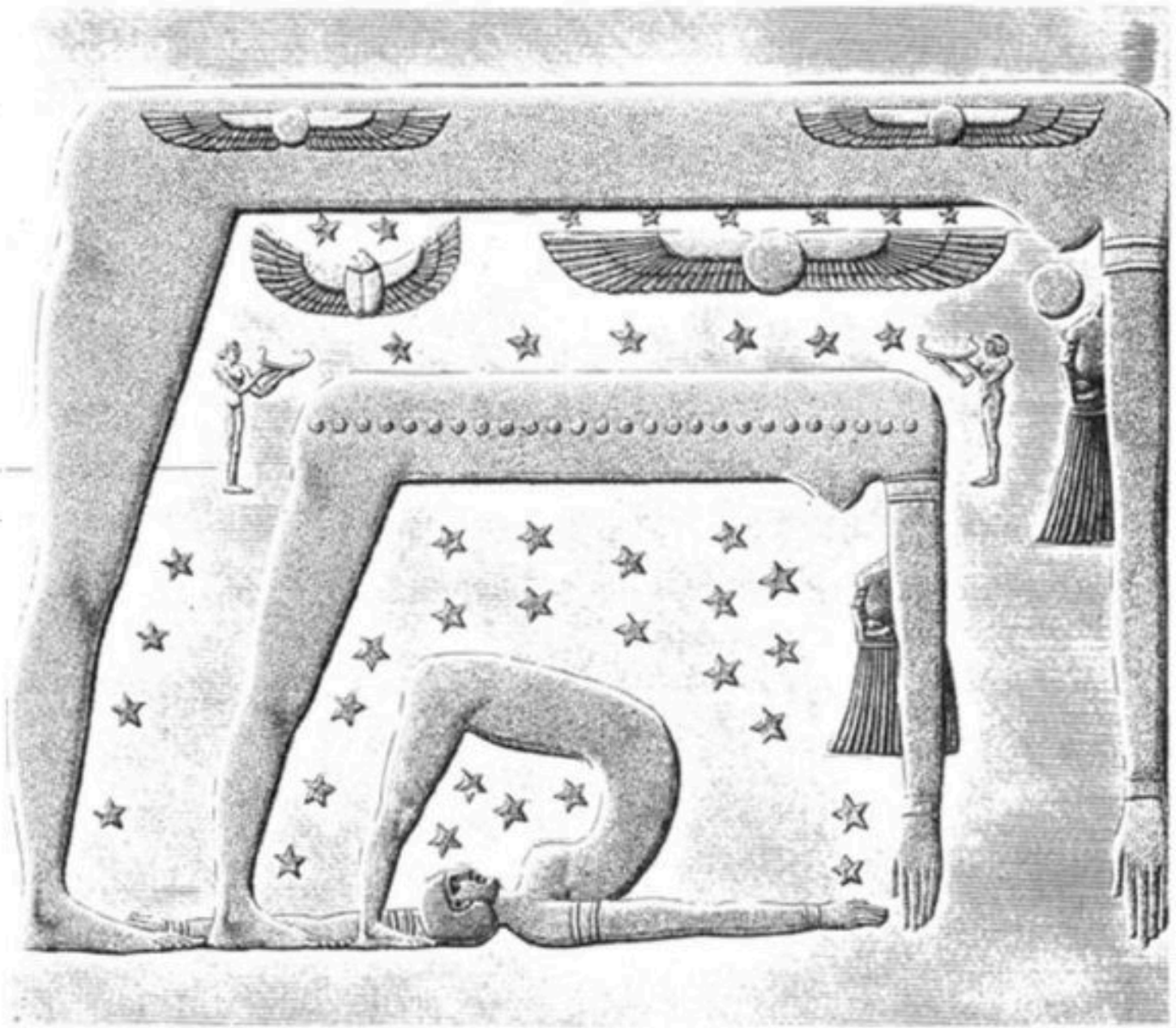

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http://fr.wikipedia.org/wiki/Description_de_l%27%C3%89gypte

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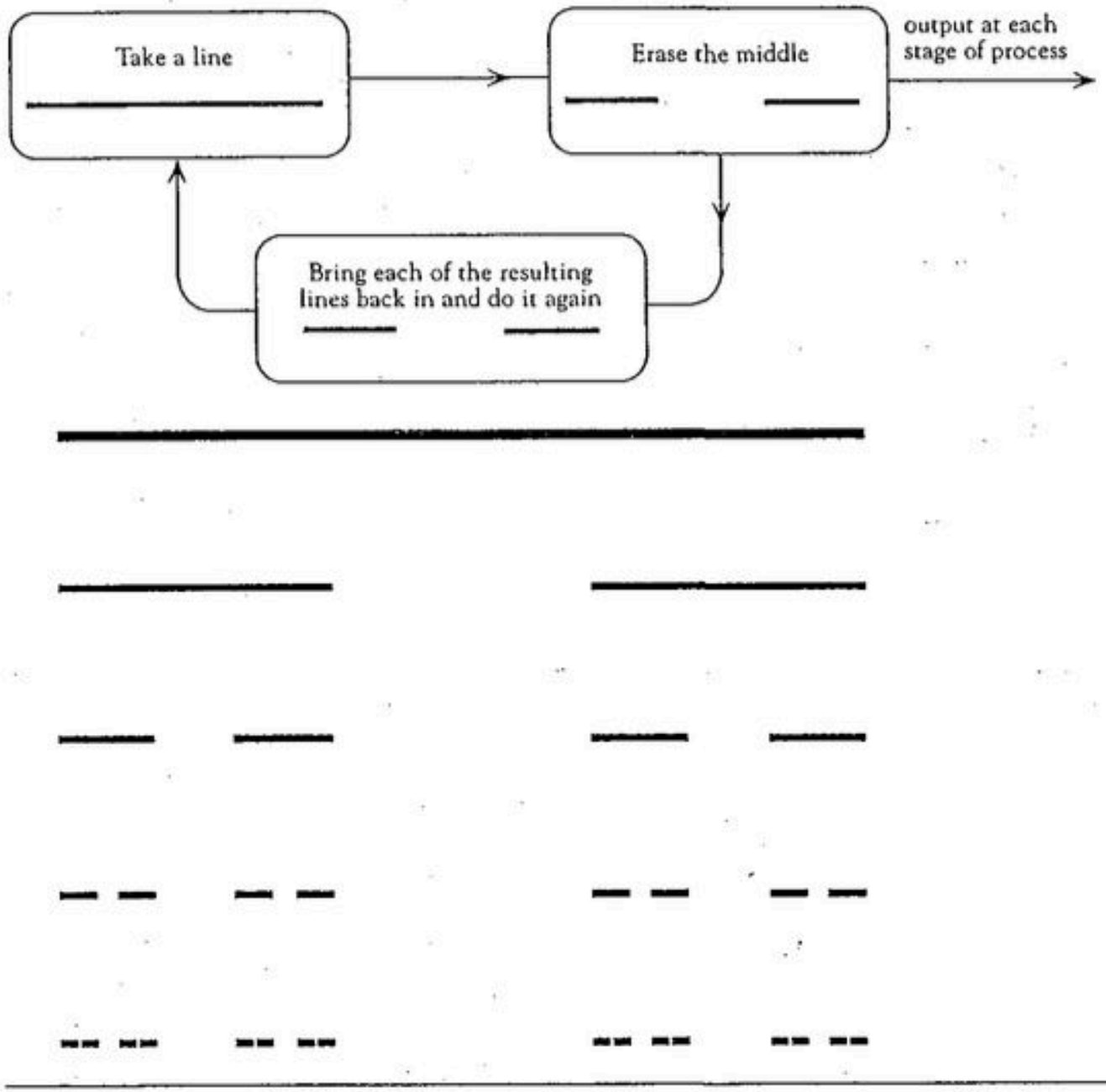

FIGURE 1.1

The Cantor set

In 1877 Georg Cantor came up with the idea of repeatedly subdividing a line to illustrate the concept of an infinite set. This looping technique is called recursion. By specifying that the recursion continues forever, Cantor was able to define an infinite set.

http://homepages.rpi.edu/~eglash/eglash.htm

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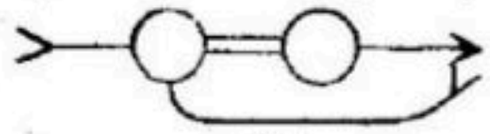
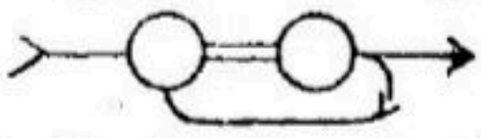
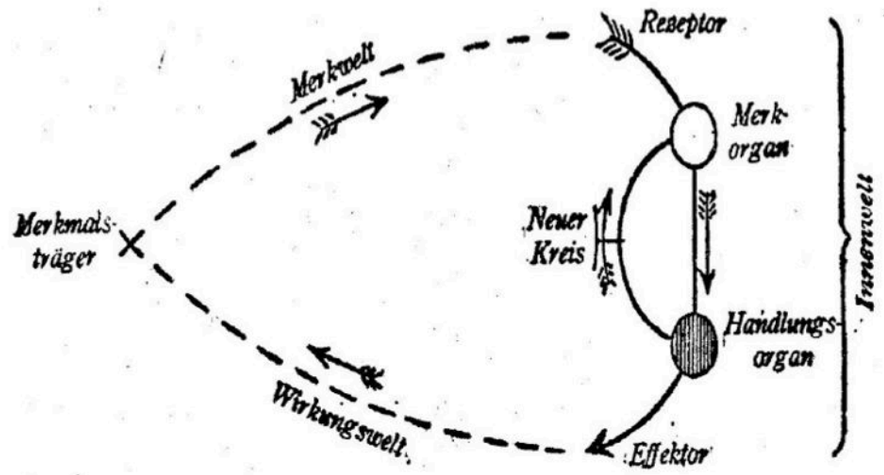
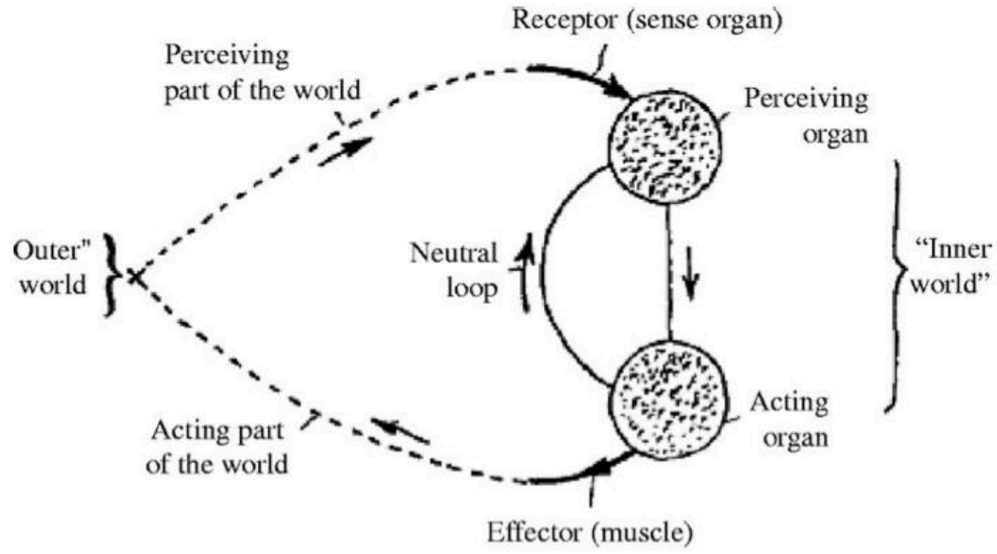
ſind zwei Fälle zu unterſcheiden: entweder wird
Effektorenmuskeln durch beſondere ſenſible Nerve
beifolgende Schema zeigt.  Oder es
toriſchen Nerven übertragene Erregung durch
Rezeptoren zum Teil aufgefangen und dem N
 Dieſe Rezeptoren bilden das zentra
Helmholtz, das anatomiſch noch völlig im Dunkeln



Figur 4.



Source: Re-drawn by the late Professor Winfired Oppelt, from the originals
©1984 IEEE

Jakob von Uexküll

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Social FeedBack

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Ratio Club

- William Ross Ashby, Horace Barlow, John Bates, George Dawson, Thomas Gold, W. E. Hick, Victor Little,Donald MacKay, Turner McLardy, P. A. Merton, John Pringle, Harold Shipton, Donald Sholl, Eliot Slater, Albert Uttley, W. Grey Walterand John Hugh Westcott. Alan Turing joined after the first meeting with I.J. Good, Philip Woodward and William Rushton added soon after. Giles Brindley was also a member for a short period.

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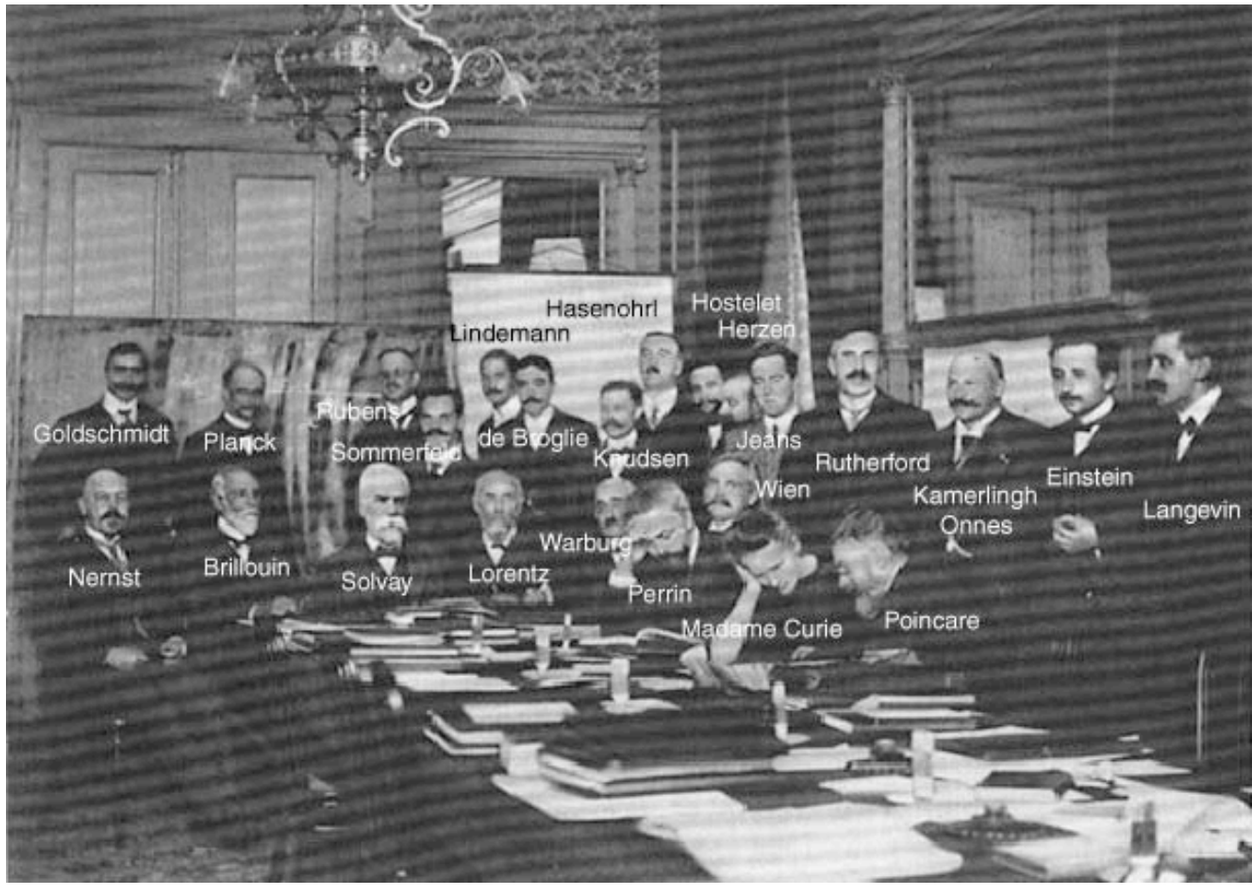
Solvay Conferences

SOLVAY CONFERENCE 1927

A. PICARD E. HENRIOT P. EHRENFEST Ed. HERSEN Th. DE DONDER E. SCHRÖDINGER E. VERSCHAFFELT W. PAULI W. HEISENBERG R.H FOWLER L. BRILLOUIN
P. DEBYE M. KNUDSEN W.L. BRAGG H.A. KRAMERS P.A.M. DIRAC A.H. COMPTON L. de BROGLIE M. BORN N. BOHR
I. LANGMUIR M. PLANCK Mme CURIE H.A. LORENTZ A. EINSTEIN P. LANGEVIN Ch.E. GUYE C.T.R. WILSON O.W. RICHARDSON
Absents : Sir W.H. BRAGG, H. DESLANDRES et E. VAN AUBEL

Forri Farg



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Manhattan Project

ULAM FEYNMAN **VON NEUMANN**

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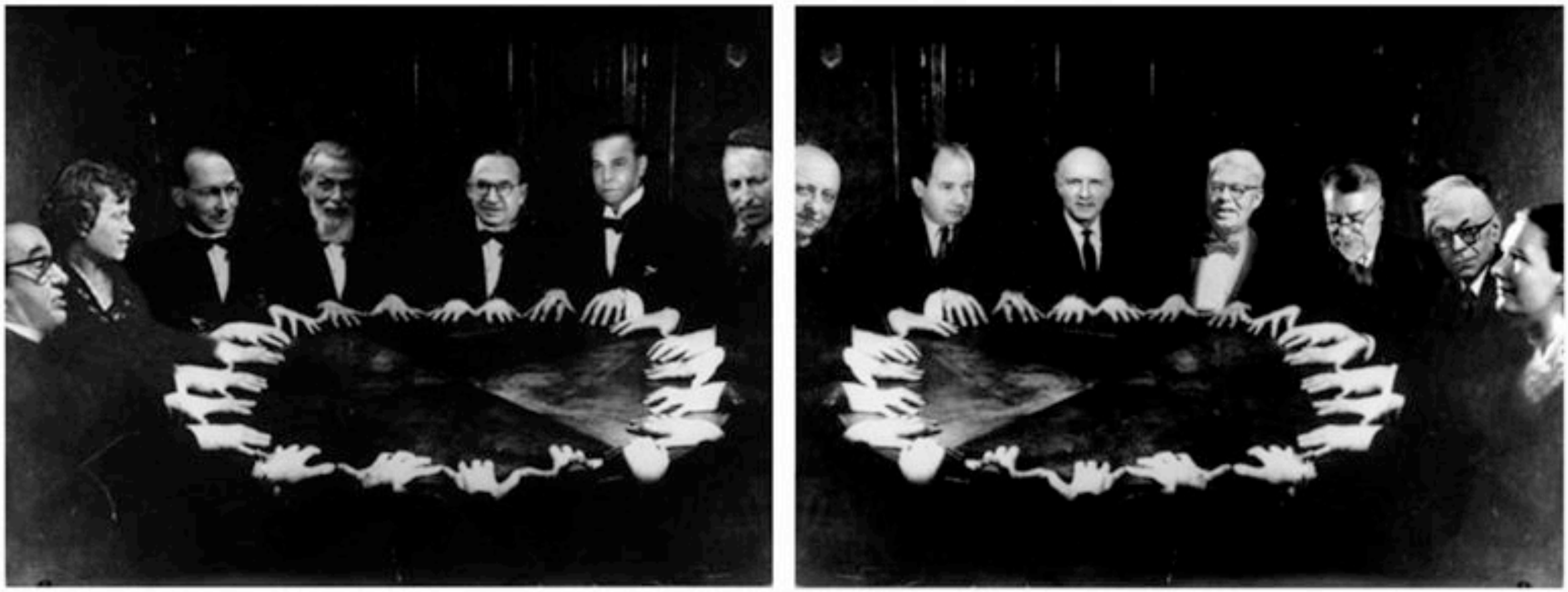
Macy Conferences 1947



- Rafael Lorente de Nó; Neurophysiologist
- Margaret Mead; cultural anthropologist
- Kurt Lewin; psychologist, often regarded as the founder of social psychology
- Warren S. McCulloch; psychiatrist, neurophysiologist and cybernetician
- Paul Lazarsfeld; sociologist and founder of Columbia University's Bureau for Applied Social Research
- Arturo Rosenblueth; researcher, physician, physiologist and a pioneer of cybernetics
- Gregory Bateson; anthropologist, social scientist, linguist, visual anthropologist, semiotician and cyberneticist
- Ralph W. Gerard; neurophysiologist and behavioral scientist known for his work on the nervous system, nerve metabolism, psychopharmacology, and biological basis of schizop
- John von Neumann; one of the foremost mathematicians of the 20th century
- Heinz von Foerster; biophysicist, scientist combining physics and philosophy and architect of cybernetics
- Lawrence K. Frank; social scientist
- Norbert Wiener; mathematician and founder of cybernetics
- Heinrich Klüver; psychologist
- Molly Harrower; pioneering clinical psychologist

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Art of Steering

Kubernetikon

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Attirée par la lumière et sachant contourner l'obstacle, la tortue de P.-A. Amouriq est le mieux agencé des robots cybernétiques.

P.-A. AMOURIQ REPLACE LES ROUES AVANT DE LA TORTUE, QUI SONT SIMPLEMENT PORTEUSES

UN LYCÉEN A CONSTRUIT UN ANIMAL ARTIFICIEL

UN animal artificiel de plus, et fabriqué par un jeune homme de dix-sept ans ?... Simple « bricolage » d'amateur imité des précédents, sera-t-on tenté de penser.

Mais d'abord quand Paul-Alain Amouriq, alors élève de « mathelem » à Louis-le-Grand (il prépare aujourd'hui sa licence ès sciences) le construisit, c'était il y a deux ans, et nul n'avait encore donné de descendance aux fameuses « tortues » de Grey Walter.

Ensuite cet engin autonome et automatique n'a rien d'une improvisation. Bien au contraire, il est calculé ; c'est le mieux construit, le mieux agencé des diverses « tortues », le seul qui ne soit pas réalisé avec de simples pièces de « meccano ». Il faut préciser que le lycéen bénéficia du concours d'une grande firme d'appareils de mesures électriques dont son père est directeur.

Tout entière usinée en duralumin, sa machine n'est pas une simple copie améliorée des « espèces » antérieures d'animaux artificiels. Elle présente plusieurs dispositifs originaux.

Une inspiration puisée dans « Science et Vie »

C'est en lisant l'article consacré par *Science et Vie* aux tortues électroniques de Grey Walter que P.-A. Amouriq, comprenant tout l'intérêt de

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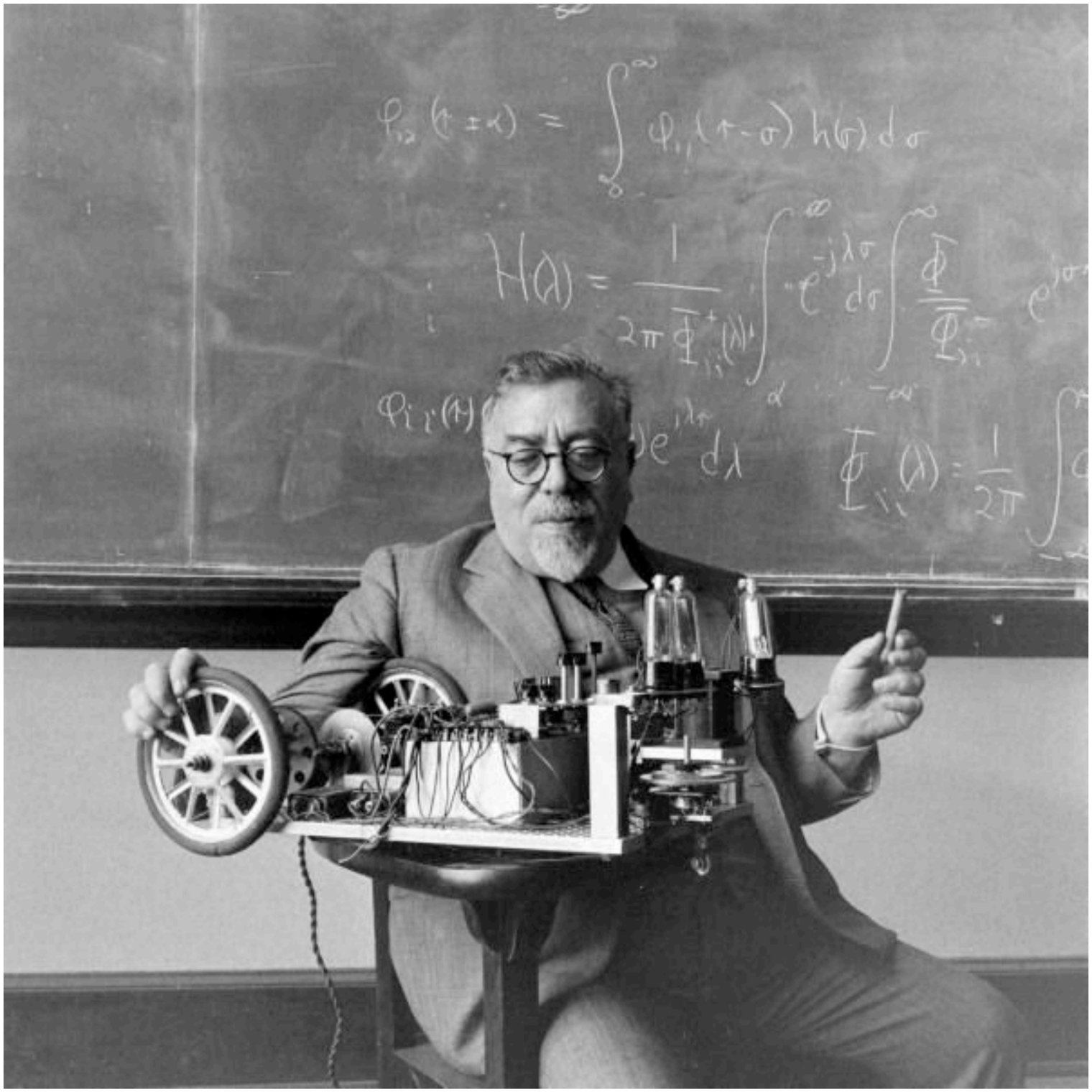

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THE FOUR PIONEERS OF CYBERNETICS GET TOGETHER IN PARIS:
left to right: W. Ross Ashby, W. McCulloch, Grey Walter and Norbert Wiener.

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Norbert Wiener
Warren MacCulloch
Ross Ashby
Gordon Pask

Paul Pangaro

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Progress of Cybernetics

Volume 1

Main Papers

The Meaning of Cybernetics

Neuro- and Biocybernetics

Edited by

J. ROSE

Blackburn College of Technology and Design

Hon. Secretary International Cybernetics Congress Committee

Proceedings of the First International Congress of Cybernetics
London, 1969

GORDON AND BREACH SCIENCE PUBLISHERS
London New York Paris

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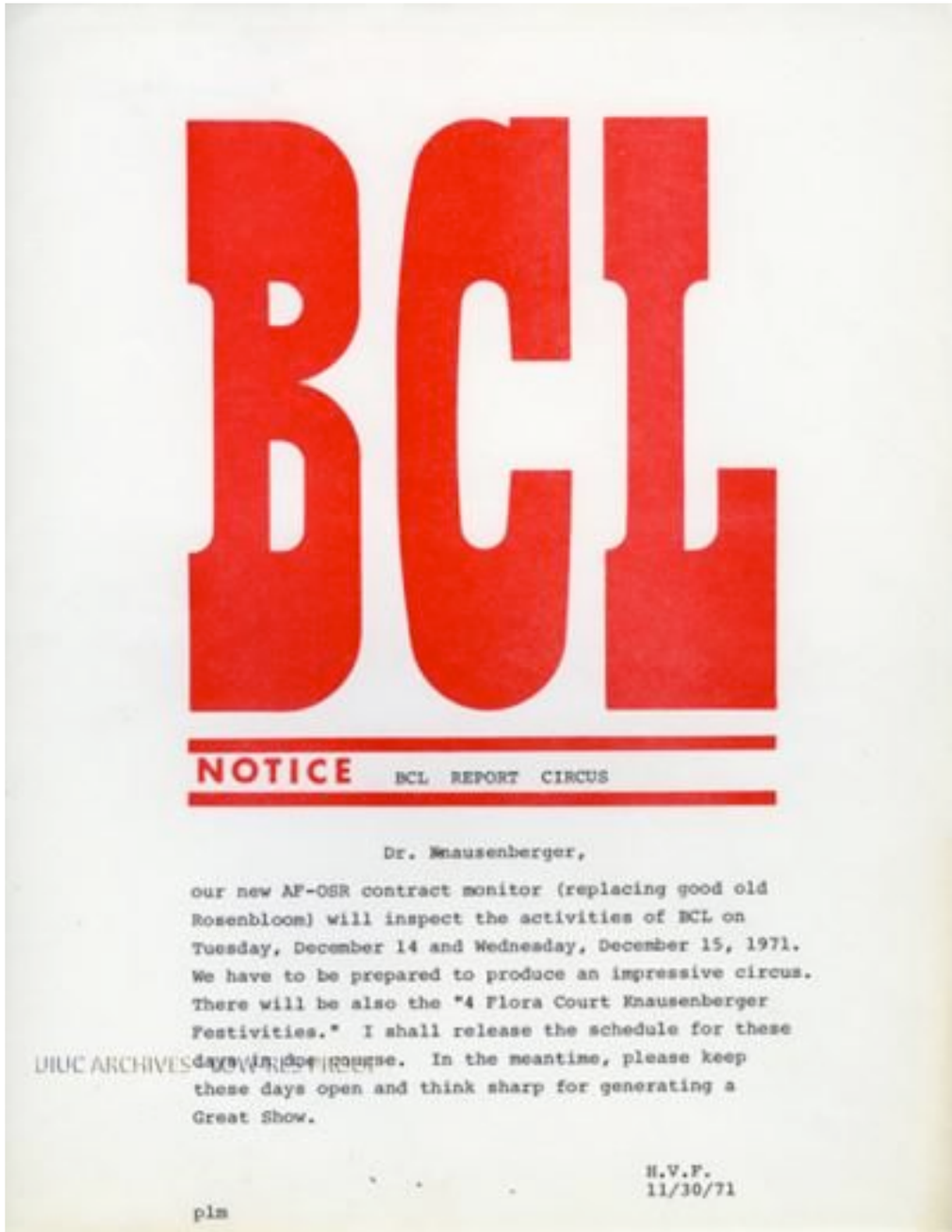
Biological Computer Lab

- McCulloch
- Ashby
- Von Foerster



BCL

NOTICE BCL REPORT CIRCUS

Dr. Knausenberger,

our new AF-OSR contract monitor (replacing good old Rosenbloom) will inspect the activities of BCL on Tuesday, December 14 and Wednesday, December 15, 1971. We have to be prepared to produce an impressive circus. There will be also the "4 Flora Court Knausenberger Festivities." I shall release the schedule for these days in due course. In the meantime, please keep these days open and think sharp for generating a Great Show.

H.V.F.
11/30/71

plm

UIUC ARCHIVES

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Symbiosis

Cybernetics or Control and Communication
in the Animal and the Machine

Biology
Physics
Metaphysics
Metabiology
Man-Machine Symbiosis

JCR Licklider

THE fig tree is pollinated only by the insect *Blastophaga grossorum*. The larva of the insect lives in the ovary of the fig tree, and there it gets its food. The tree and the insect are thus heavily interdependent: the tree cannot reproduce without the insect; the insect cannot eat without the tree; together, they consitute not only a viable but a productive and thriving partnership. This cooperative "living together in intimate association, or even close union, of two dissimilar organisms" is called symbiosis.[1]

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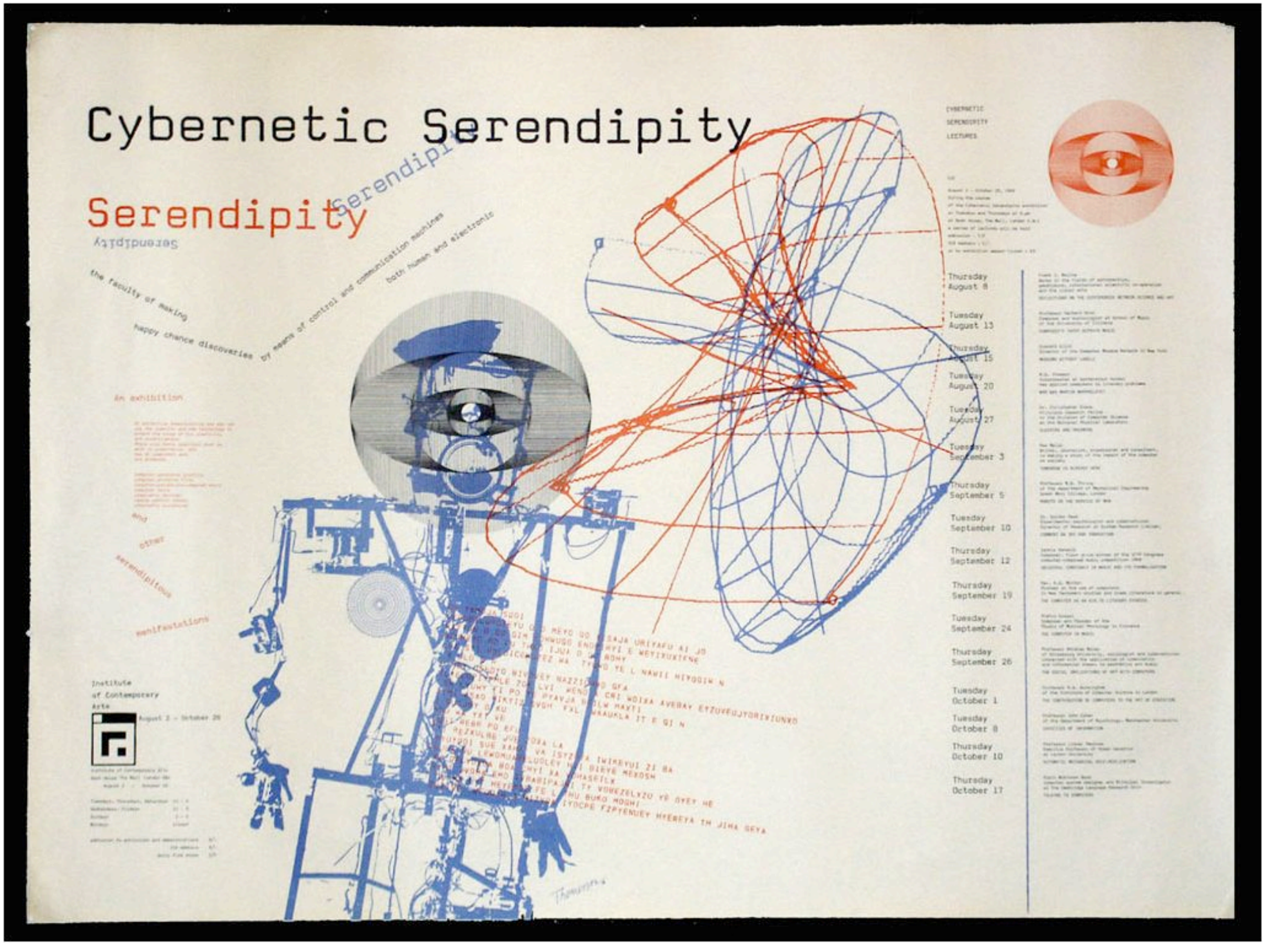
Serendipity



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Non-Conventional Computation

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Non-Conventional

Prepared for *Encyclopedia of Electrical and Electronics Engineering* (John Webster ed.), Wiley & Sons. [June 1, 1998]

Non-Conventional Computers

Tommaso Toffoli (tt@bu.edu)
ECE Department, Boston University, 8 Saint Mary's St., Boston, MA 02215

Today, a "computer", without further qualifications, denotes a rather well-specified kind of object; we'll consider a computer "non-conventional" if its physical substrate or its organization significantly depart from this de facto norm. Thus, the thousands of literate Greeks that ended up in Rome as secretaries and accountants after the "liberation" of Greece in the second century B.C. would be viewed today as non-conventional computers, even though at that time one certainly couldn't imagine a more ordinary kind of personal computer.

Furthermore, we'll be more concerned with features that ultimately have to be answerable to physics (the mechanisms by which the logic elements operate, the geometry of interconnection, the overall flow of energy and information) than with architectural variants of a "firmware" nature (reduced instruction set, speculative execution of program branches, etc.)

with appropriate timing can inhibit or "lock out" another signal. Indeed, using just prairie fire and passive walls one can construct on a majestic scale a fairly close approximation of a network of neurons and axons, or even a digital computer.

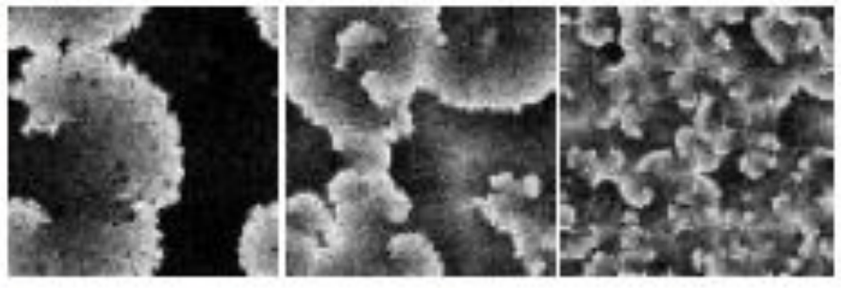

Figure 1: Propagating fire front patterns, at different scales (from a computer simulation).

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Non conventional ?

asynchronous vs synchronous (Handshake circuits)

timeless vs central clock based (Self-Timed Circuits)

non-conventional substrates:

- gas, chemistry
- biology
- microfluidics, bubble logic
- paper
- photonic computation
- sonic computer ?
- x-energy computation ...

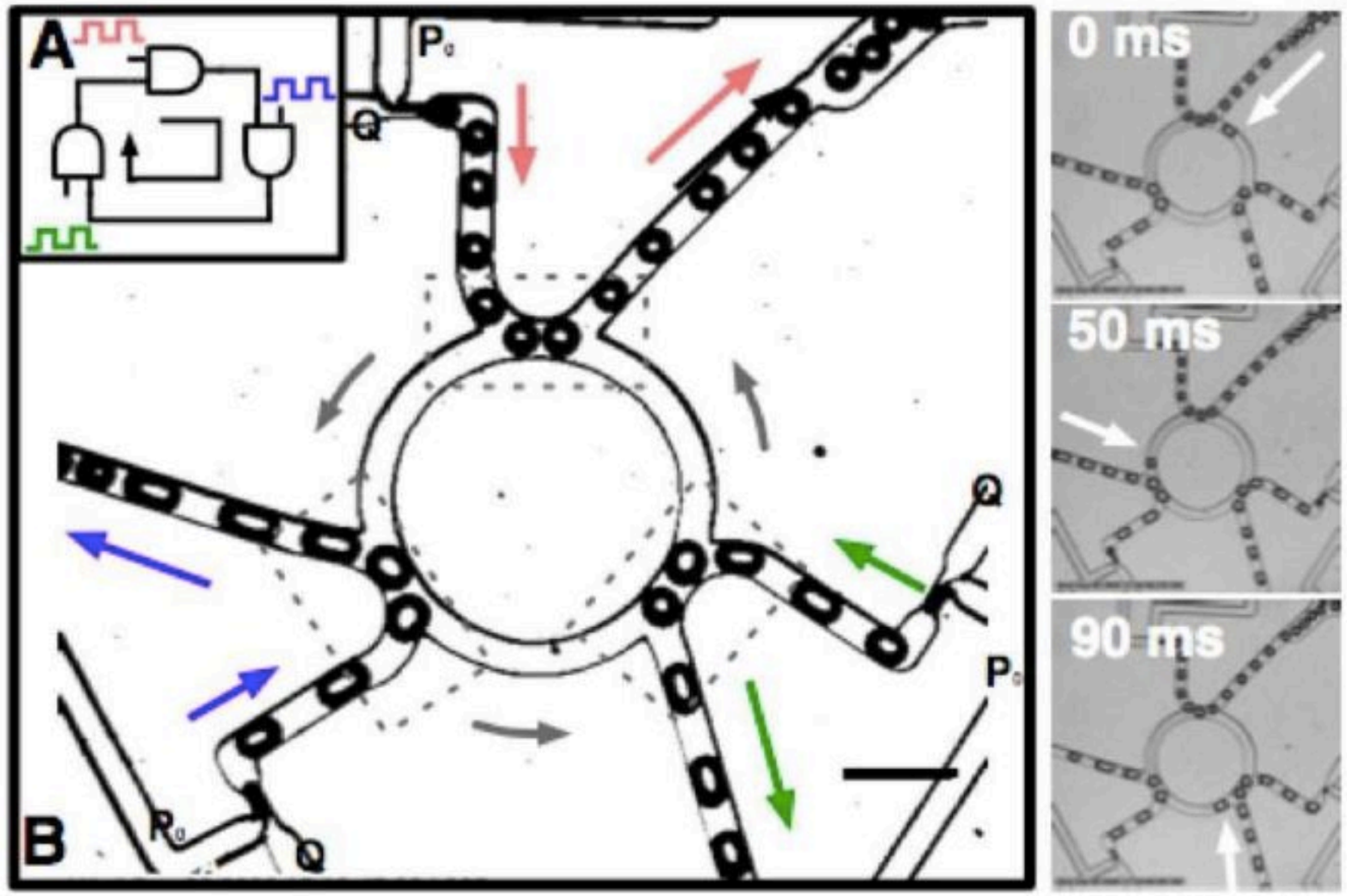

Figura 2. Microfluidic ring oscillator depicting cascading and feedback. Top inset depicts the schematic with three microfluidic AND gates connected in a ring configuration. Righ column depicts a time series of steady state operation of the oscilator at $\sim$ 10 Hz. Scale bar $\sim$ 200 μm.

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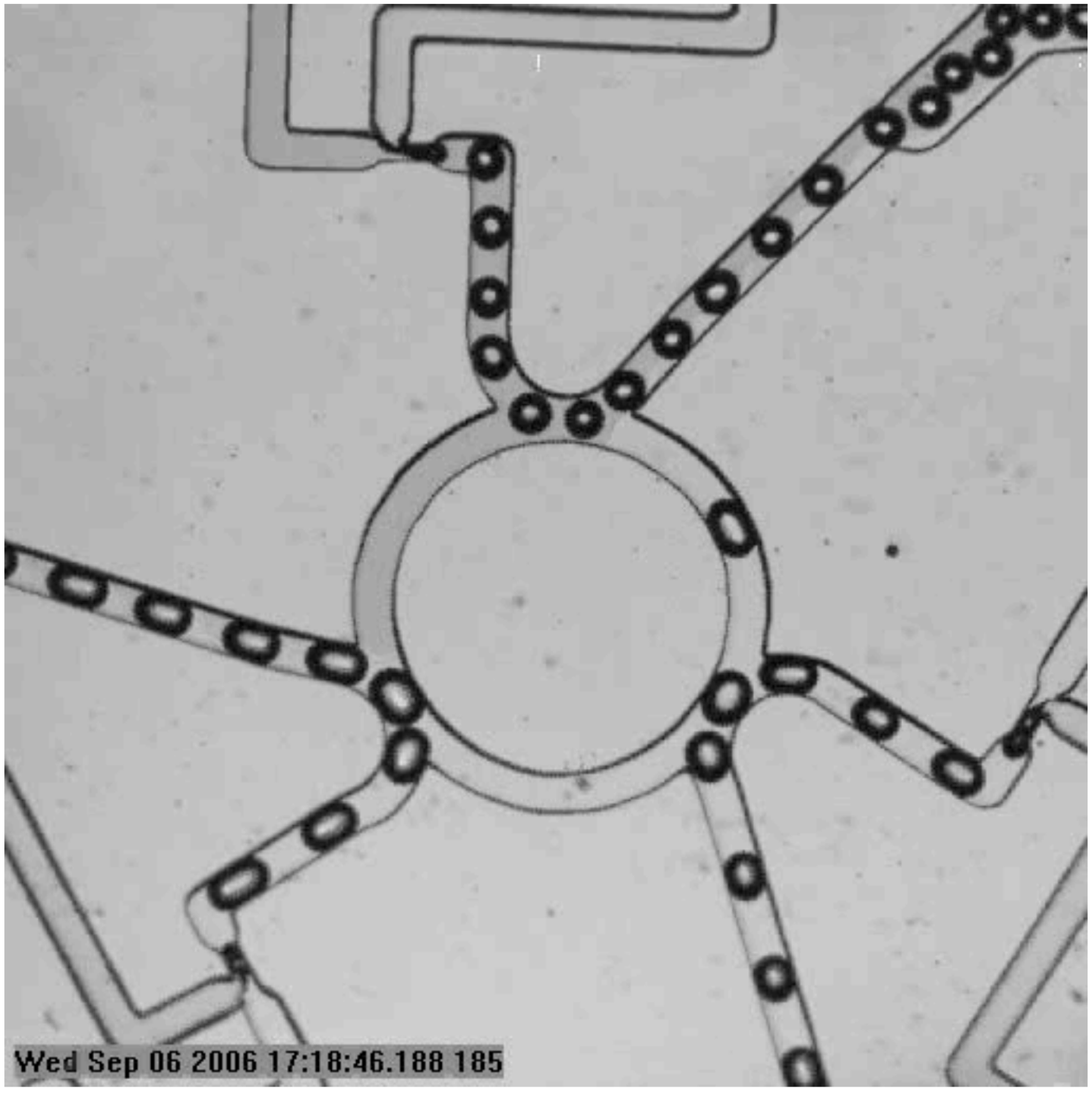

http://stanford.edu/~manup/

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Towards (real) MetaProgrammable Matter

DARPA MIT	Information Physics Tomaso Toffoli, Norman Margolus	**CAMM**	1980's
NASA MIT	Modular Robotics Xerox Parc, NASA	**Immobots**	1990's
DARPA MIT	CBA Center of Bit & Atoms Gershenfeld, Dalrymple & Al	**RALA, MilliBio**	2000's
DARPA Berkeley, University of Virginia (formerly MIT)	ARC Asynchronous Research Center Ivan Sutherland, Adam Megacz	**FLEET, Infinity, MARINA**	
NSF VPRI	FONC Foundation of New Computation Alan Kay & Al	**STEP , MARU**	
MIT MIT Media Lab	RA Radical Atoms Hiroshi Ishii & Al	**ZeroN, InForm**	2010's

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Information Physics

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MIT/LCS/TM-151

REVERSIBLE COMPUTING

Tommaso Toffoli

February 1980

REVERSIBLE COMPUTING*

Tommaso Toffoli

MIT Laboratory for Computer Science
545 Technology Sq., Cambridge, MA 02139

Abstract. The theory of reversible computing is based on invertible primitives and composition rules that preserve invertibility. With these constraints, one can still satisfactorily deal with both functional and structural aspects of computing processes; at the same time, one attains a closer correspondence between the behavior of abstract computing systems and the microscopic physical laws (which are presumed to be strictly reversible) that underly any concrete implementation of such systems.

Here, we integrate into a comprehensive picture a variety of concepts and results. According to a physical interpretation, the central result of this paper is that *it is ideally possible to build sequential circuits with zero internal power dissipation*. Even when these circuits are interfaced with conventional ones, power dissipation at the interface would be at most proportional to the number of input/output lines, rather than to the number of logic gates as in conventional computers.

Keywords. Reversible computing, computation universality, automata, computing networks, physical computing.

http://publications.csail.mit.edu/lcs/pubs/pdf/MIT-LCS-TM-151.pdf

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Physica 10D (1984) 81–95
North-Holland, Amsterdam

PHYSICS-LIKE MODELS OF COMPUTATION*

Norman MARGOLUS
MIT Laboratory for Computer Science, Cambridge Massachusetts 02139, USA

Reversible Cellular Automata are computer-models that embody discrete analogues of the classical-physics notions of space, time, locality, and microscopic reversibility. They are offered as a step towards models of computation that are closer to fundamental physics.

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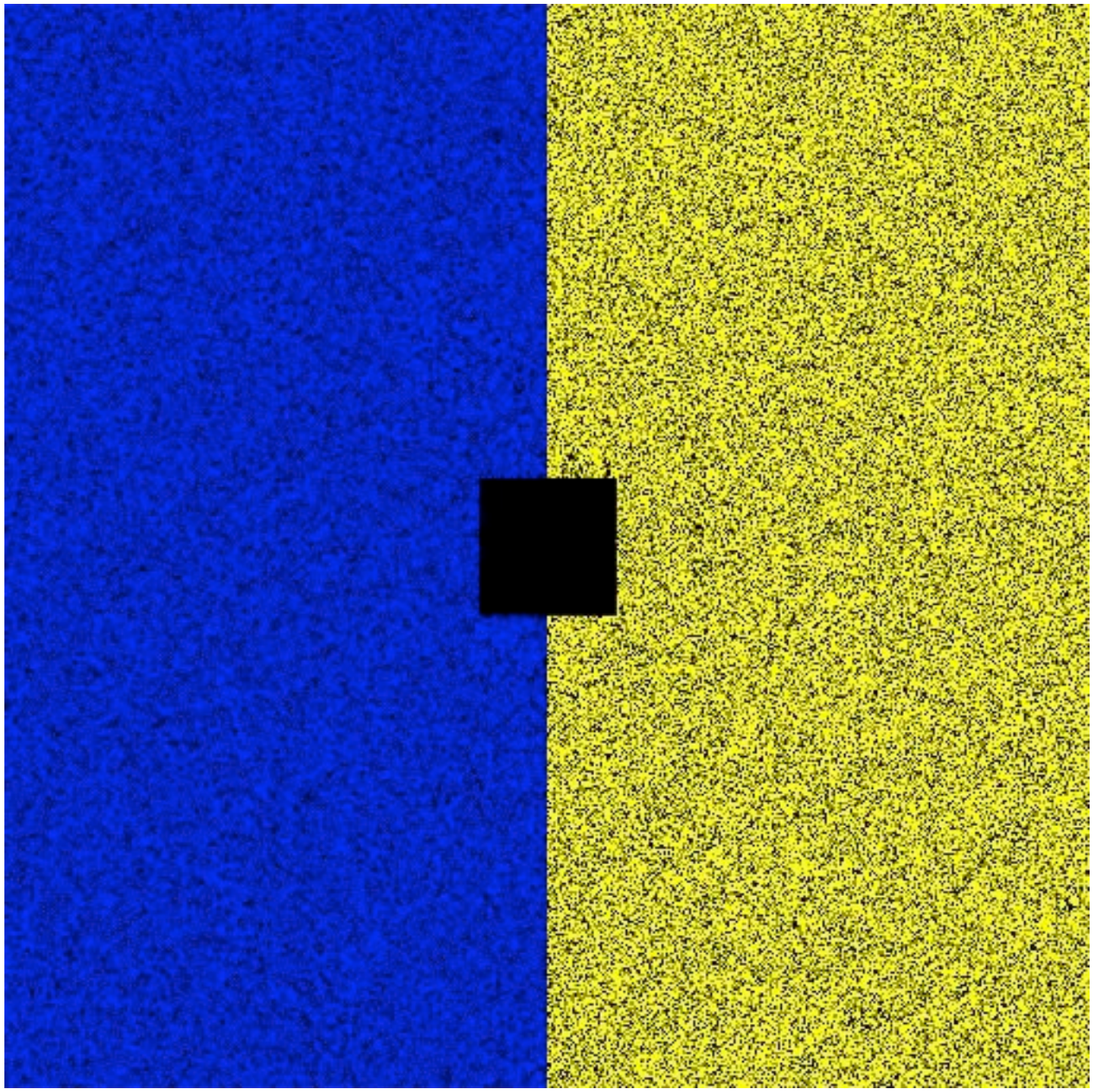

Diffusion and sound waves in a reversible lattice gas (10MB): the four direction TM lattice gas is started with a 50% density of particles, except for an empty region (black) in the center. Half of the particles are colored blue and half yellow, so that both diffusion and waves are visible at the same time. The lattice is 512x512.

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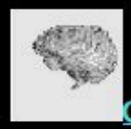
Information Mechanics

exploring a new band of the computational spectrum

Welcome to the Information Mechanics Group home page.

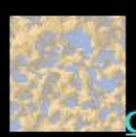
The MIT Information Mechanics Group

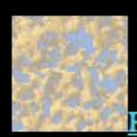
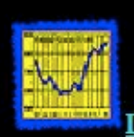
IM was a research group at the MIT Laboratory of Computer Science (LCS) from 1977 to 1994. Some of the activity of this group has moved to the Computer Science and Artificial Intelligence Laboratory, where Norm Margolus is a Research Affiliate. Several former members are still active in the field of Physics of Computation and in related Cellular Automata research, and some CA hardware and software development continues.

Former Group Members

CAM8 Collaborators

Physics of Computation

This group was focused on the Physics of Computation, and on Physics-like Cellular Automata models. We felt that information and computation are fundamental concepts in Nature, and that informational modeling is of more than just practical interest.


Cellular Automata

CA Hardware and Software

Physics of Computation Seminar Speakers

IM Final Progress Report

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International Journal of Theoretical Physics, Vol. 42, No. 2, February 2003 (© 2003)

Looking at Nature as a Computer

Norman Margolus[1,2]

Received May 13, 2002

Although not always identified as such, information has been a fundamental quantity in Physics since the advent of Statistical Mechanics, which recognized "counting states" as the fundamental operation needed to analyze thermodynamic systems. Quantum Mechanics (QM) was invented to fix the infinities that arose classically in trying to count the states of Black Body radiation. In QM, both amount and rate of change of information in a finite physical system are finite. As Quantum Statistical Mechanics developed, classical finite-state models naturally played a fundamental role, since only the finite-state character of the microscopic substratum normally enters into the macroscopic counting. Given more than a century of finite-state underpinnings, one might have expected that by now *all* of physics would be based on informational and computational concepts. That this isn't so may simply reflect the stubborn legacy of the continuum, and the recency and macroscopic character of computer science. In this paper, I discuss the origins of informational concepts in physics, and reexamine computationally some fundamental dynamical quantities.

KEY WORDS: information; entropy; energy; action; cellular automaton; quantum mechanics.

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Mechanical Systems that are both Classical and Quantum

Norman Margolus*

5 Jun 2008

arXiv:0805.3357v2 [quant-ph] 20

Abstract

Quantum dynamics can be regarded as a generalization of classical finite-state dynamics. This is a familiar viewpoint for workers in quantum computation, which encompasses classical computation as a special case. Here this viewpoint is extended to mechanics, where classical dynamics has traditionally been viewed as a macroscopic approximation of quantum behavior, not as a special case.

When a classical dynamics is recast as a special case of quantum dynamics, the quantum description can be interpreted classically. For example, sometimes extra information is added to the classical state in order to construct the quantum description. This extra information is then eliminated by representing it in a superposition as if it were unknown information about a classical statistical ensemble. This usage of superposition leads to the appearance of Fermions in the quantum description of classical lattice-gas dynamics and turns continuous-space descriptions of finite-state systems into illustrations of classical sam-

digital movie looks like it is changing continuously in time, but in fact it is actually a discrete sequence of digital images.

Something similar is true of nature. Although the world looks to our senses as if it has an infinite amount of resolution in both space and time, in fact a finite-sized physical system with a finite energy has only a finite amount of distinguishable detail and this detail changes at only a finite rate [27].

1.1 A bit of history

The finite character of the states of physical systems came as a great surprise when it became apparent at the start of the twentieth century. The revolution was started by Max Planck in 1900 when he found that he had to introduce a new constant into physics in order to understand the thermodynamics of electromagnetic radiation in a cavity. The new constant fixed the statistical mechanical analysis, but it did so by making the count of distinct possible states finite.

Planck's constant has a particularly simple inter-

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Modular Robotics

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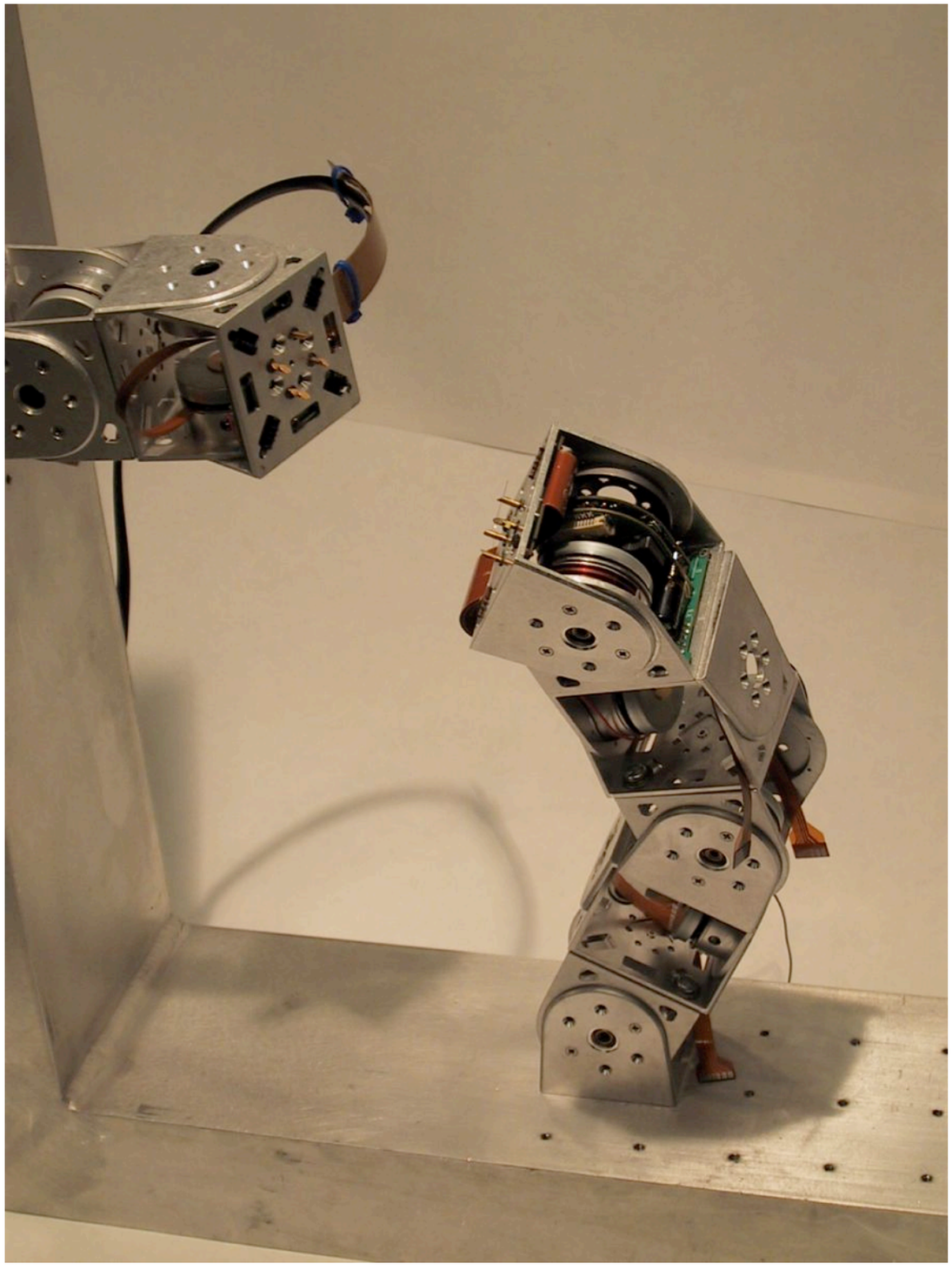
http://nlp.stanford.edu/~wcmac/p/interests.html



http://en.wikipedia.org/wiki/Self-reconfiguring_modular_robot

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Immobile Robots
AI in the New Millennium[1]

Brian C. Williams and P. Pandurang Nayak

■ A new generation of sensor-rich, massively distributed, autonomous systems are being developed that have the potential for profound social, environmental, and economic change. These systems include networked building energy systems, autonomous space probes, chemical plant control systems, satellite constellations for remote ecosystem monitoring, power grids, biospherelike life-support systems, and reconfigurable traffic systems, to highlight but a few. To achieve high performance, these immobile robots (or immobots) will need to develop sophisticated regulatory and immune systems that accurately and robustly control their complex internal functions. Thus, immobots will exploit a vast nervous system of sensors to model themselves and their environment on a grand scale. They will use these models to dramatically reconfigure themselves to survive decades of autonomous operation. Achieving these large-scale modeling and configuration tasks will require a tight coupling between the higher-level coordination function provided by symbolic reasoning and the lower-level autonomic processes of adaptive estimation and control. To be economically viable, they will need to be programmable purely through high-level compositional models. Self-modeling and

ward AI's central goal of developing agent architectures and a theory of machine intelligence (Etzioni and Segal 1992). As Etzioni and Segal argue, software environments, such as a UNIX shell and the World Wide Web, provide softbots with a set of ready-made sensors (for example, LS and GOPHER) and end effectors (for example, FTP and TELNET) that are easy to maintain but still provide a test bed for exploring issues of mobility and real-time constraints. At the same time, the recent Internet gold rush and the ensuing web literacy has provided an enormous textual corpus that screams for intelligent information-gathering aides (Levy, Rajaraman, and Ordille 1996; Knoblock and Levy 1995).

However, two concerns have been raised about using software agents as a research test bed and application domain: First, softbots often operate in an environment lacking the rich constraints that stem from noisy, analog sensors and complex nonlinear effectors that are so fundamental to physical environments. Can such a software environment adequately drive research on agent kernels? Second, giv-

http://groups.csail.mit.edu/mers/papers/1229-1226-1-PB.pdf

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https://www.aaai.org/Papers/AAAI/1996/
AAAI96-144.pdf

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A Model-based Approach to Reactive Self-Configuring Systems*

Brian C. Williams and P. Pandurang Nayak
Recom Technologies, NASA Ames Research Center, MS 269-2
Moffett Field, CA 94305 USA
E-mail: williams,nayak@ptolemy.arc.nasa.gov

Abstract

This paper describes Livingstone, an implemented kernel for a model-based reactive self-configuring autonomous system. It presents a formal characterization of Livingstone's representation formalism, and reports on our experience with the implementation in a variety of domains. Livingstone provides a reactive system that performs significant deduction in the sense/response loop by drawing on our past experience at building fast propositional conflict-based algorithms for model-based diagnosis, and by framing a model-based configuration manager as a propositional feedback controller that generates focused, optimal responses. Livingstone's representation formalism achieves broad coverage of hybrid hardware/software systems by coupling the transition system models underlying concurrent reactive languages with the qualitative representations developed in model-based reasoning. Livingstone automates a wide variety of tasks using a single model and a single core algorithm, thus making significant progress towards achieving a central goal of model-based reasoning. Livingstone, together with the IISTS planning and scheduling engine and the RAPS executive, has been selected as part of the core autonomy architecture for NASA's first New Millennium spacecraft.

quickly, using component-based models wherever possible to automatically generate flight software. Finally, the space of failure scenarios and associated responses will be far too large to use software that requires prelaunch enumeration of all contingencies. Instead, the spacecraft will have to reactively think through the consequences of its reconfiguration options.

We made substantial progress on each of these fronts through a system called *Livingstone*, an implemented kernel for a model-based reactive self-configuring autonomous system. This paper presents a formalization of the reactive, model-based configuration manager underlying Livingstone. Several contributions are key. First, the approach unifies the dichotomy within AI between deduction and reactivity (Agre & Chapman 1987, Brooks 1991). We achieve a reactive system that performs significant deduction in the sense/response loop by drawing on our past experience at building fast propositional conflict-based algorithms for model-based diagnosis, and by framing a model-based configuration manager as a propositional feedback controller that generates focused, optimal responses. Second, our modeling formalism represents a radical shift from first order logic, traditionally used to characterize model-

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CBA Center for Bits & Atoms

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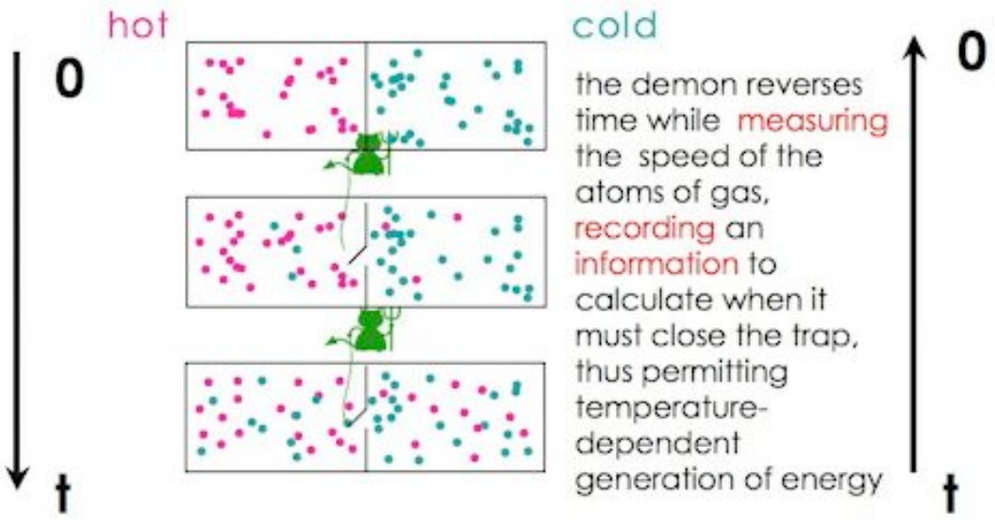
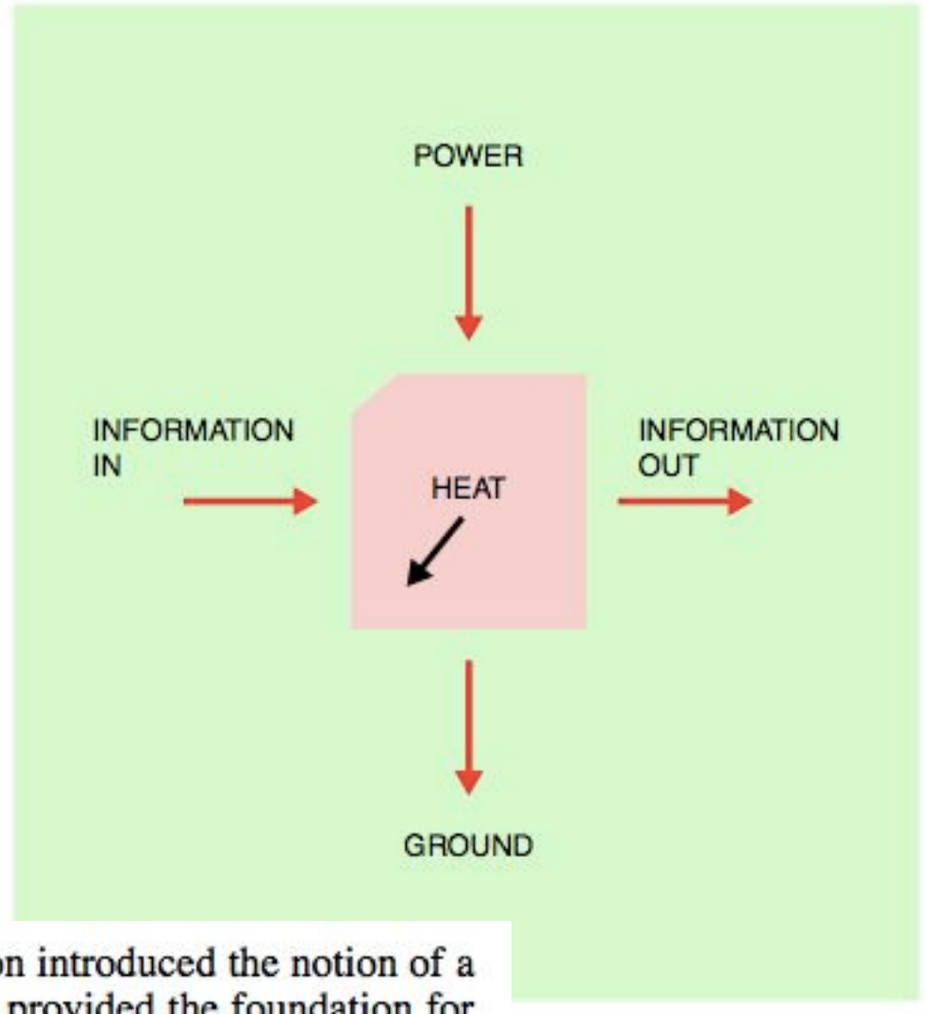
Leo Szilard



http://www.normalesup.org/~adanchin/science/maxwell.html

http://cba.mit.edu/docs/papers/96.isj.ent.pdf



Szilard's formulation introduced the notion of a bit of information, which provided the foundation for Shannon's theory of information[4] and, hence, modern coding theory. Through the study of the thermodynamics of computation, information theory is now returning to its roots in heat engines.

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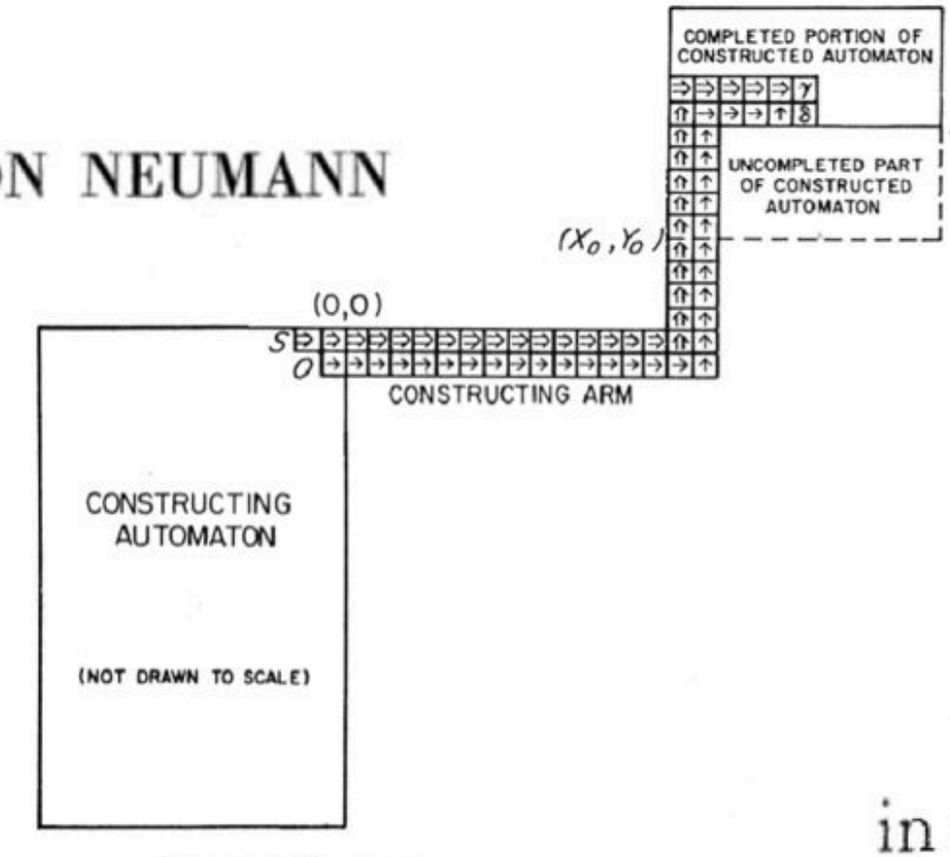
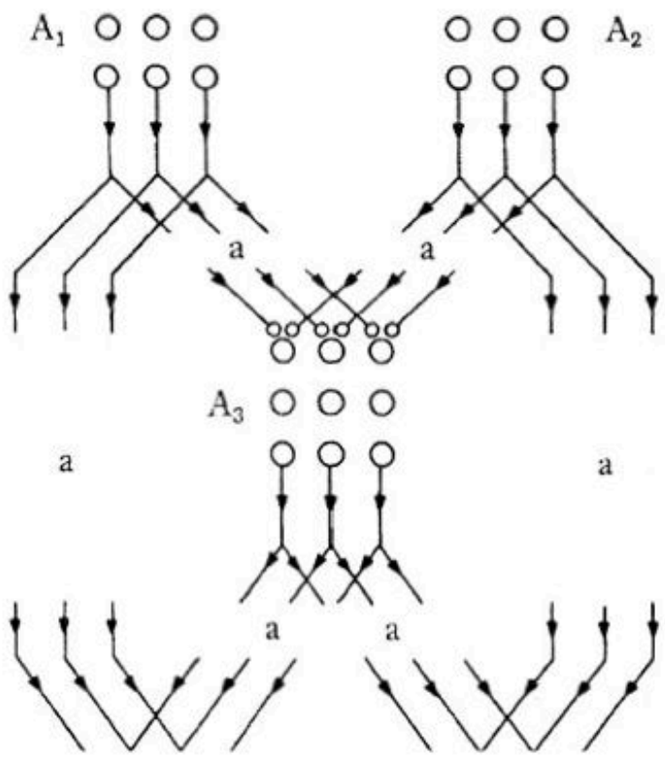
Theory of
Self-Reproducing Automata

JOHN VON NEUMANN



Fourth Lecture

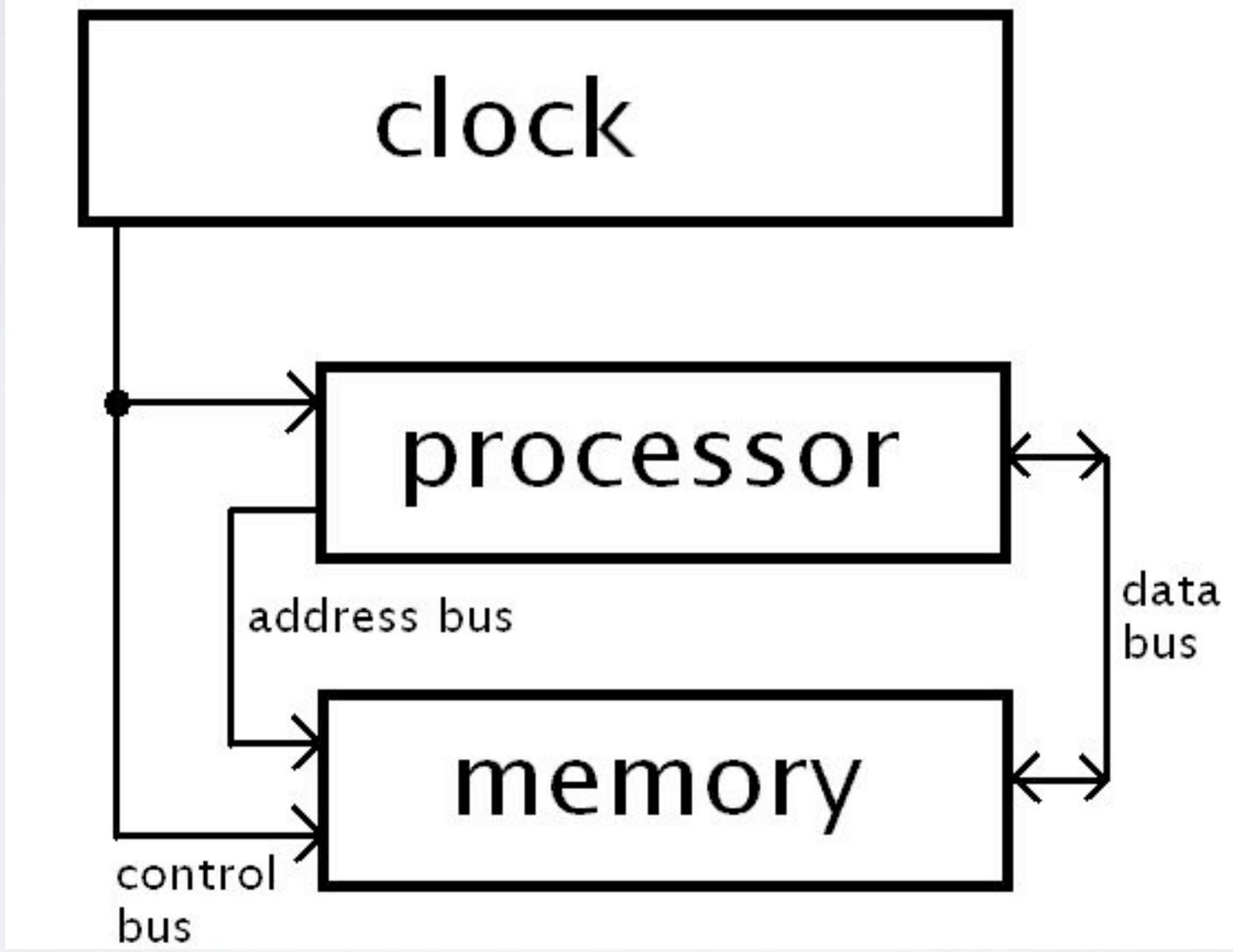


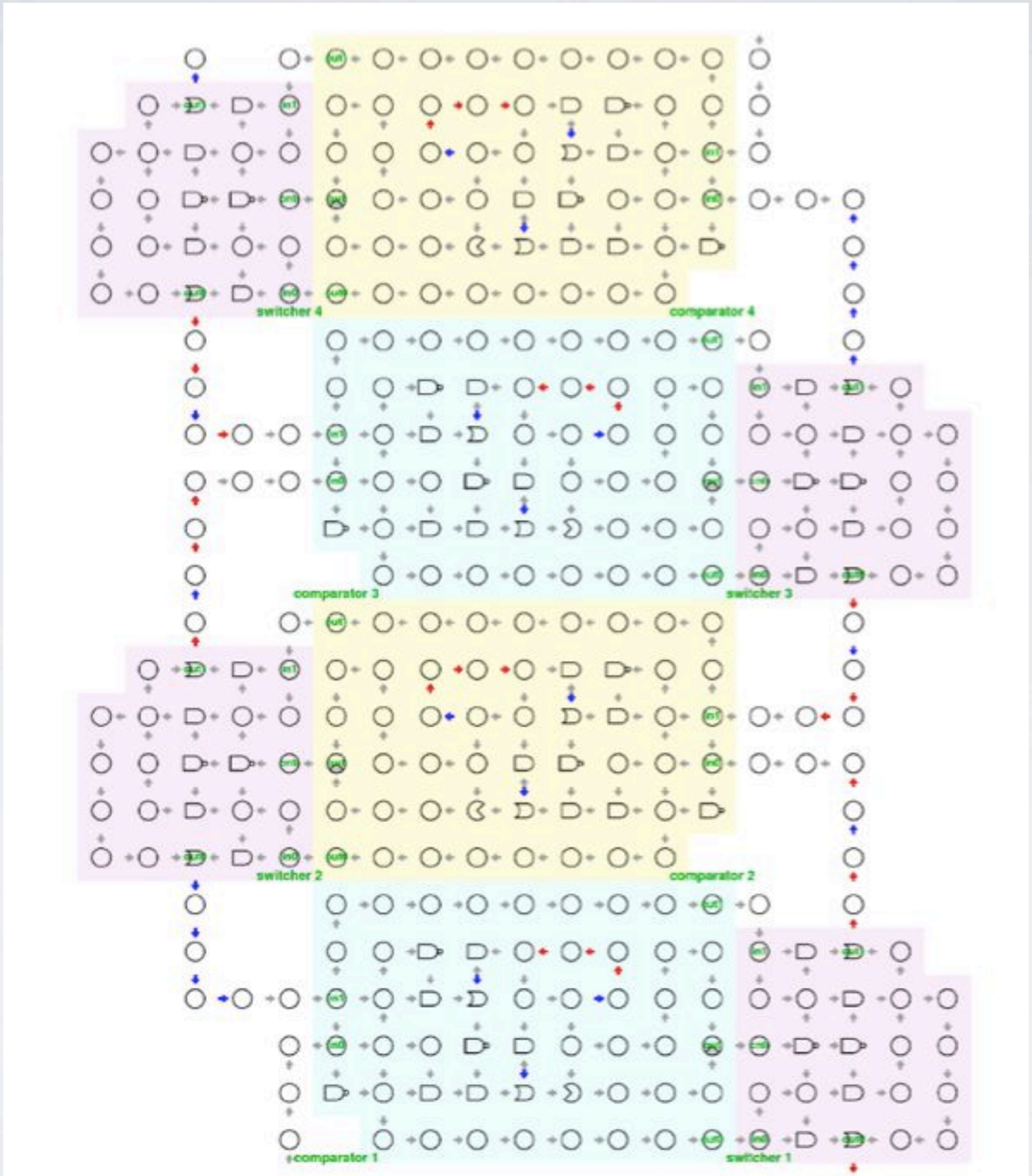
Reliable Computation in the Presence of Noise

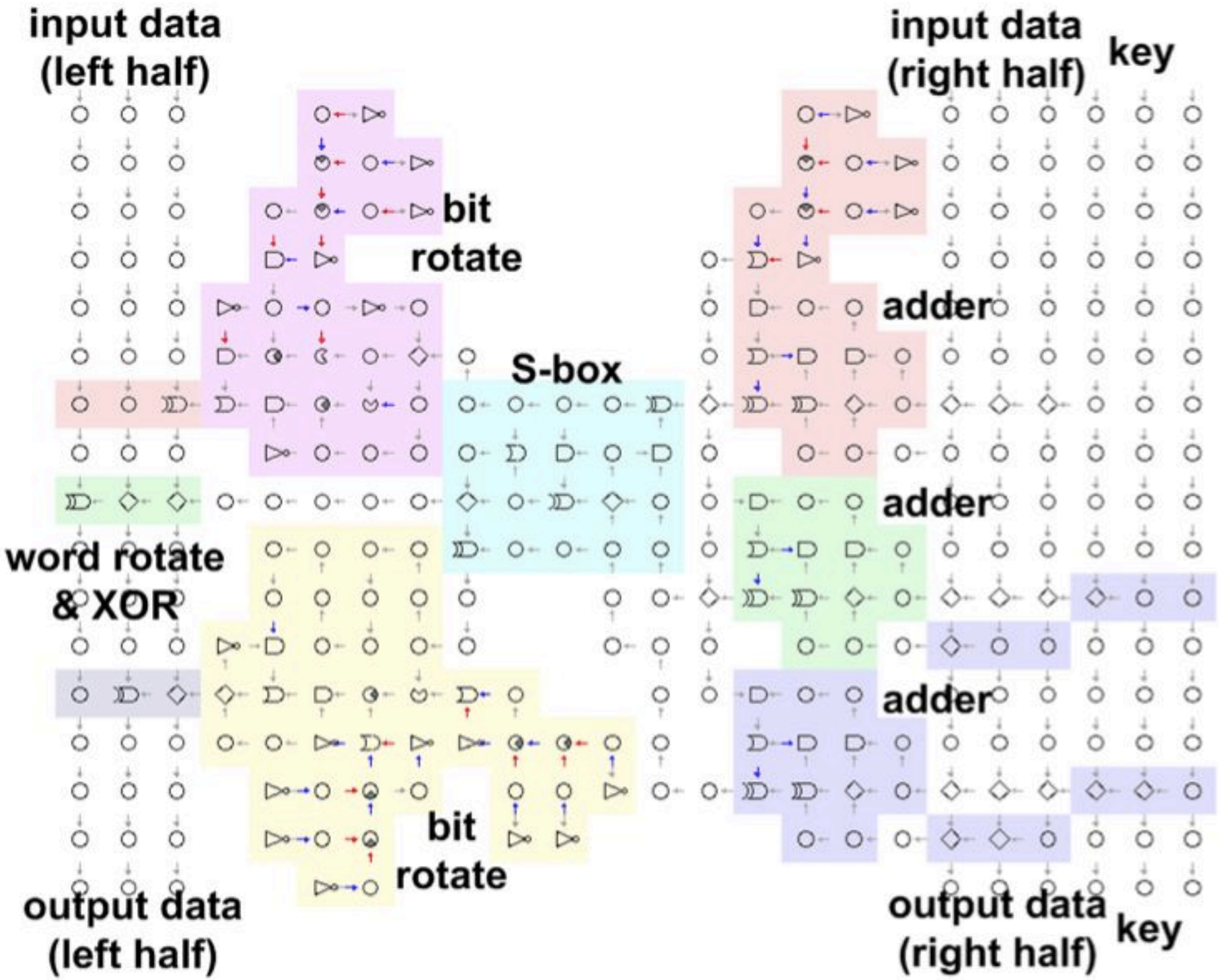
THE ROLE OF HIGH AND OF EXTREMELY HIGH COMPLICATION

S. Winograd and *J. D. Cowan*

Von Neumann architecture




switcher 4
comparator 4
comparator 3
switcher 3
switcher 2
comparator 2
comparator 1
switcher 1


input data
(left half)
bit
rotate
S-box
input data
(right half)
key
adder
word rotate
& XOR
adder
bit
rotate
output data
(left half)
output data
(right half)
key

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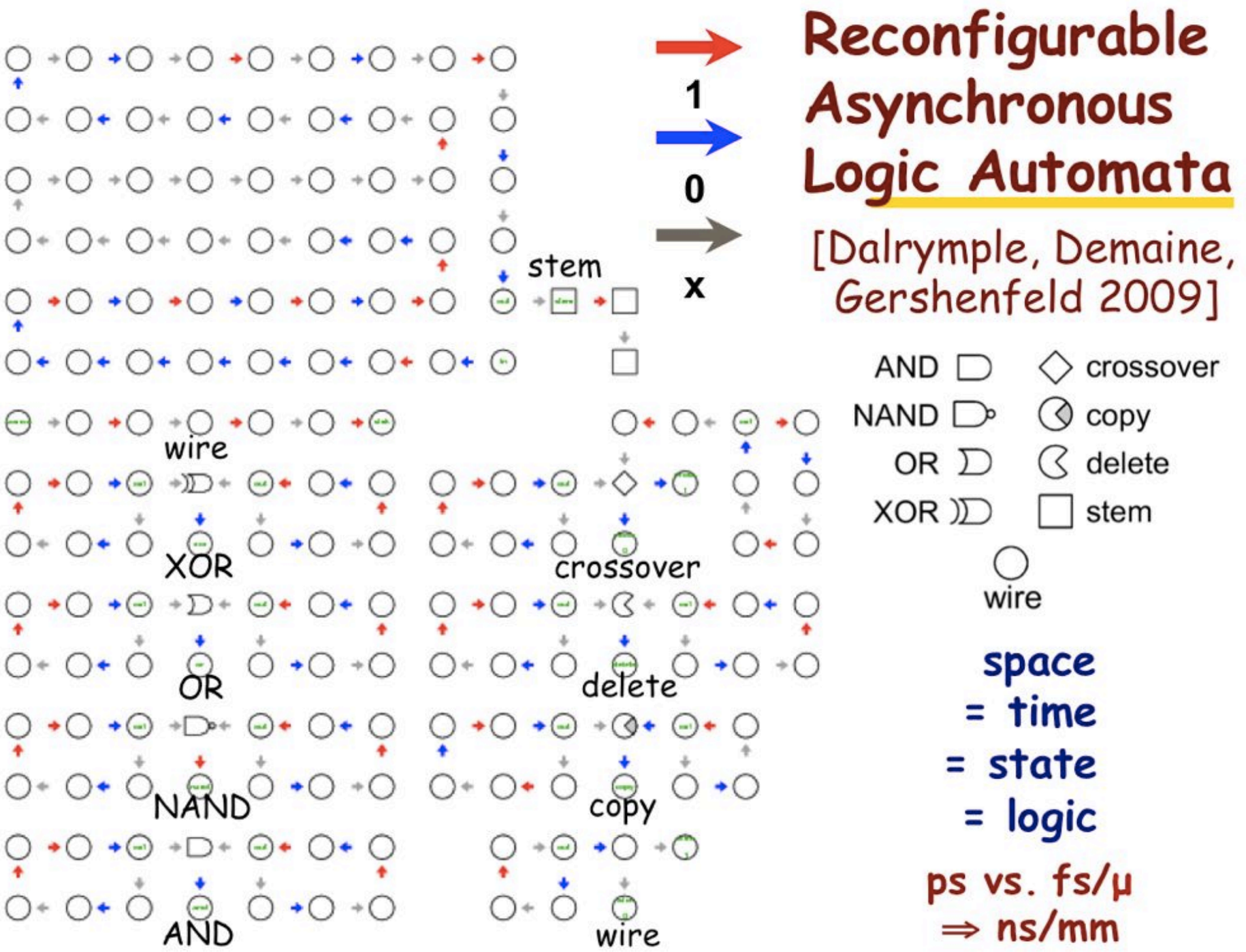

Reconfigurable Asynchronous Logic Automata

[Dalrymple, Demaine, Gershenfeld 2009]

AND
NAND
OR
XOR
crossover
copy
delete
stem
wire

space
= time
= state
= logic

ps vs. fs/μ
⇒ ns/mm

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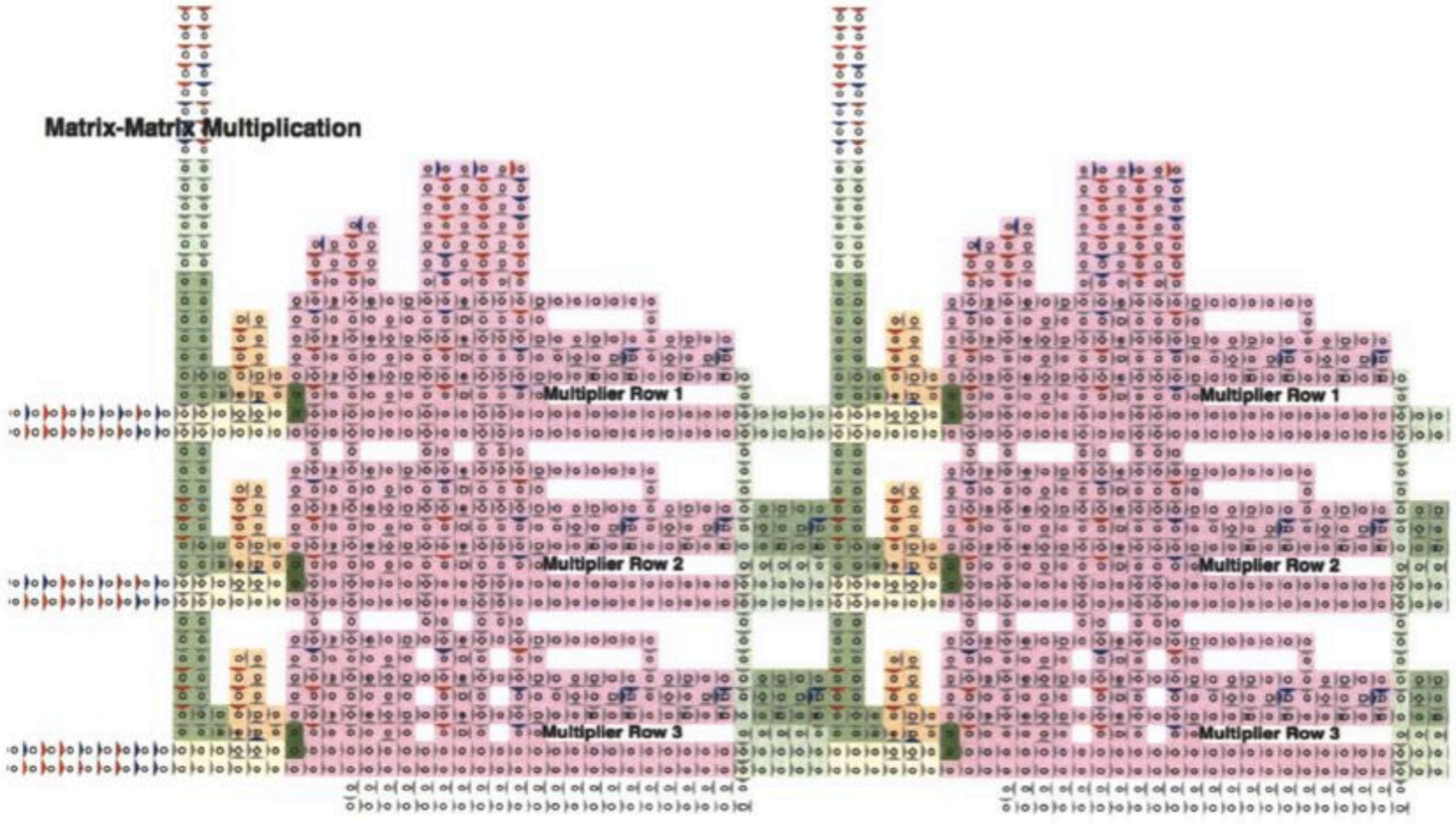

Figure 08. RALA program - Matrix-Matrix Multiplication with Logic Gates as distributed computing

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Massachusetts Institute of Technology

OTHERlab

DARPA

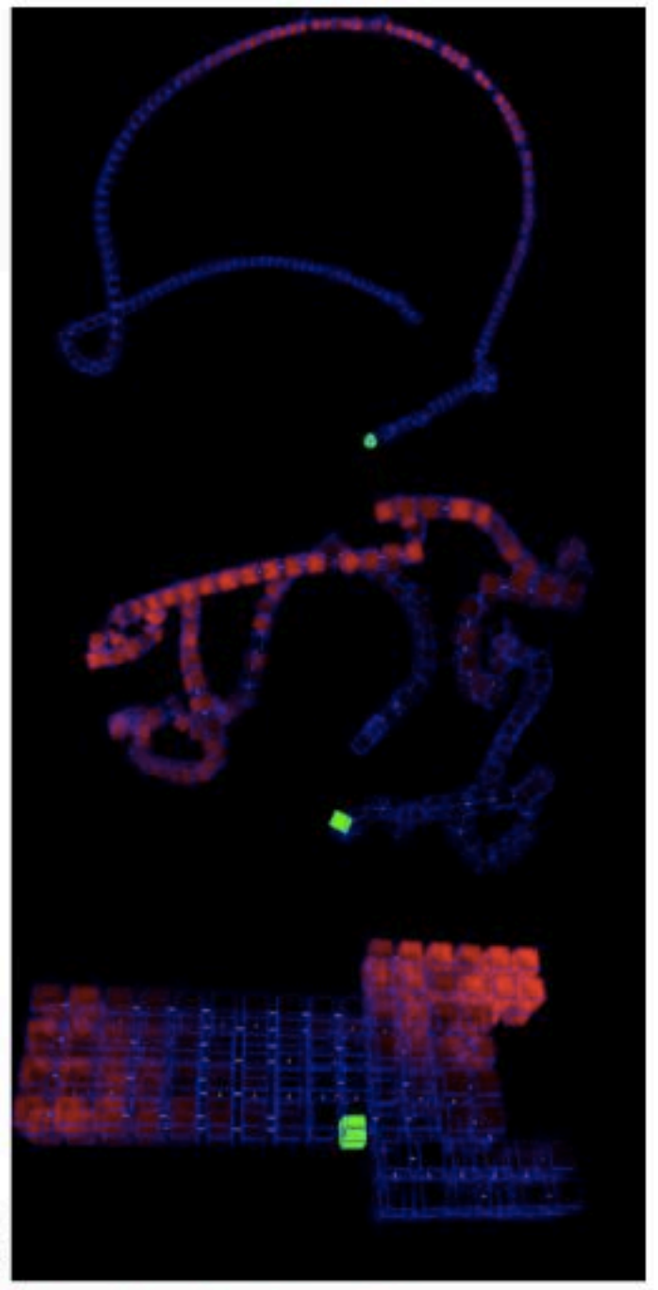
BIOLOGY

PROGRAMMABLE ASSEMBLY

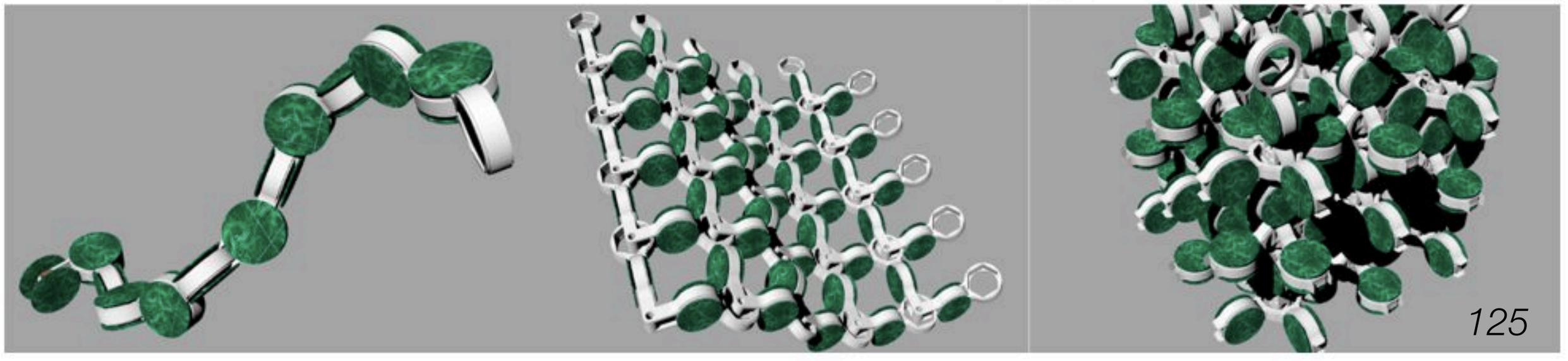
CODED ASSEMBLY

SELF ASSEMBLY

Milli-Biology



nm — um — mm — cm — Length scale



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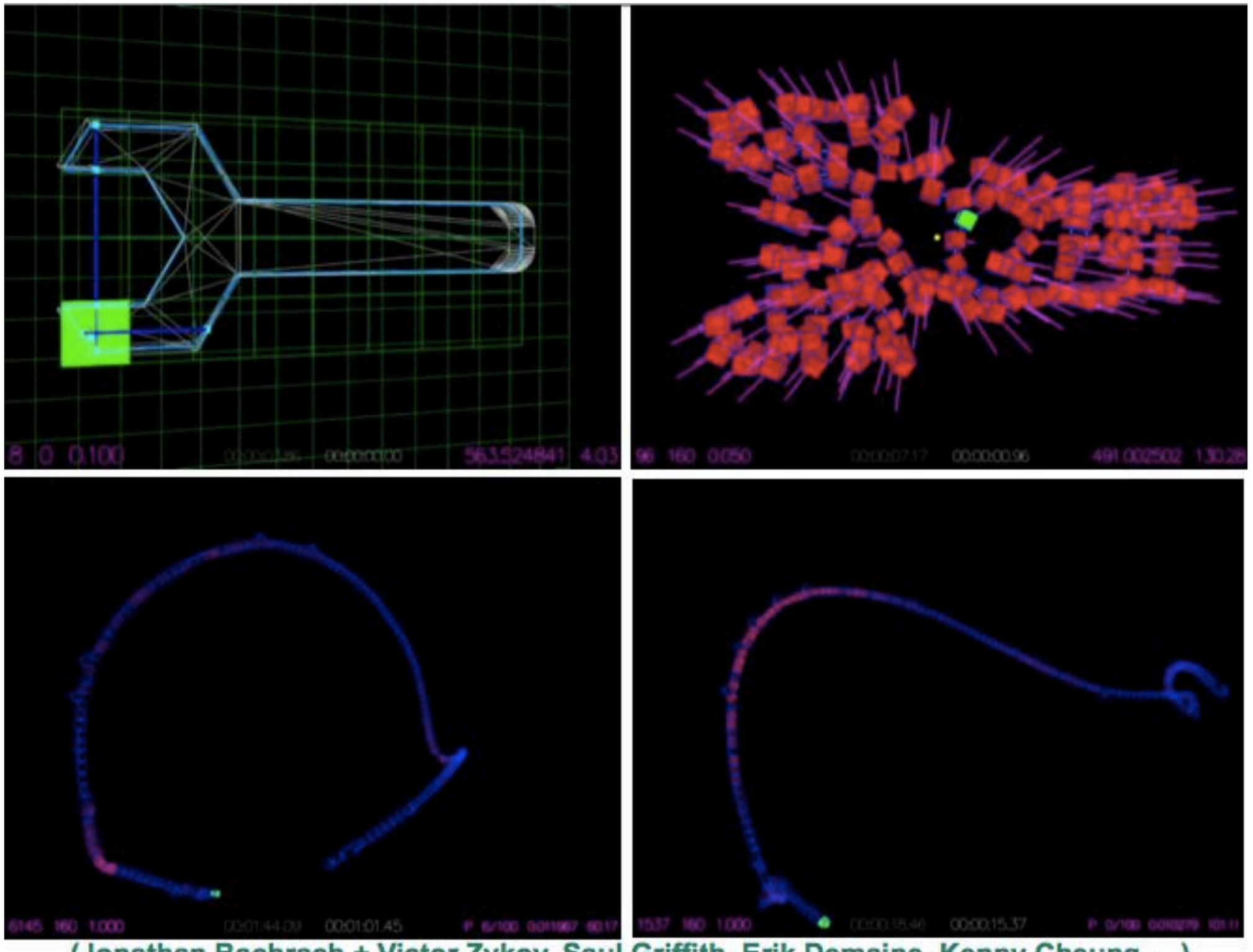

(Jonathan Bachrach + Victor Zykov, Saul Griffith, Erik Demaine, Kenny Cheung, ...)

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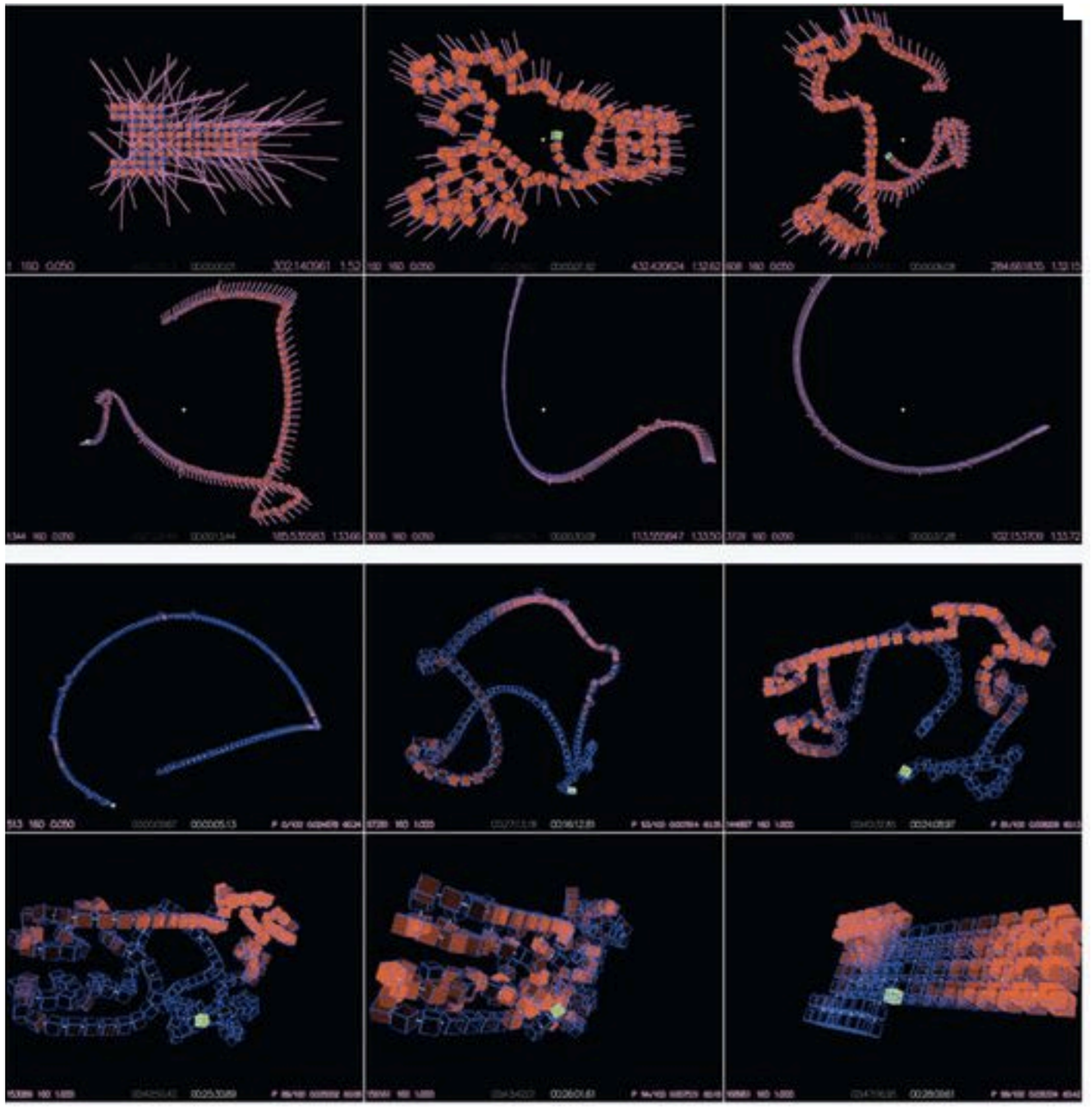

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ARC Asynchronous Research Center

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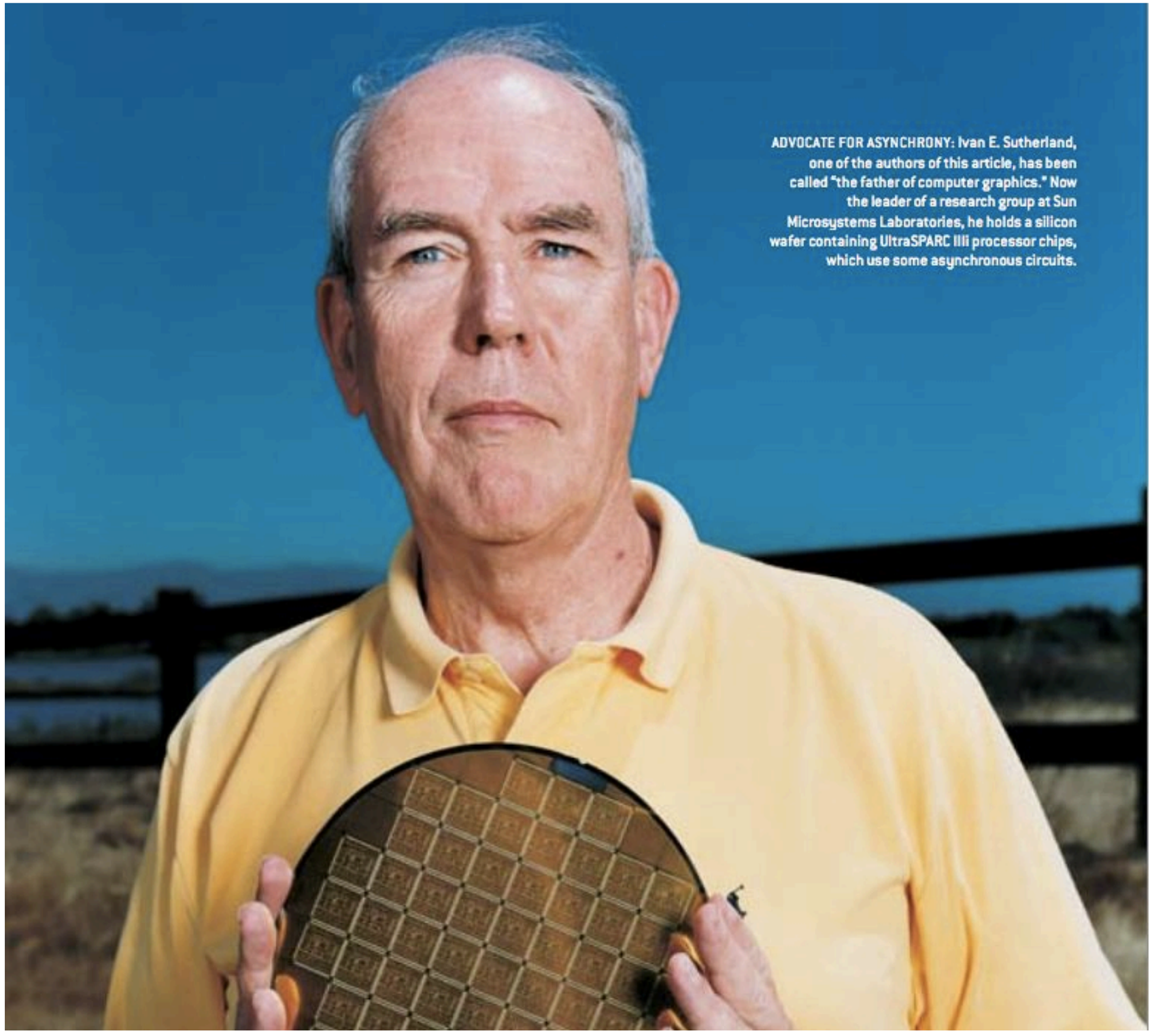

ADVOCATE FOR ASYNCHRONY: Ivan E. Sutherland, one of the authors of this article, has been called "the father of computer graphics." Now the leader of a research group at Sun Microsystems Laboratories, he holds a silicon wafer containing UltraSPARC IIIi processor chips, which use some asynchronous circuits.

http://www.cs.virginia.edu/~robins/Computing_Without_Clocks.pdf

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Generalized Arrows

Adam Megacz Joseph

Doctor of Philosophy in Computer Science

University of California, Berkeley

Professor John Wawrzynek, Chair

Multi-level languages and arrows both facilitate metaprogramming, the act of writing a program which generates a program. The `arr` function required of all arrows turns arbitrary metalanguage expressions into object language expressions; because of this, arrows may be used for metaprogramming only when the object language is a superset of the metalanguage.

This thesis introduces *generalized arrows*, which are less restrictive than arrows in that they impose no containment relationship between the object language and metalanguage; this allows generalized arrows to be used for *heterogeneous* metaprogramming. This thesis also establishes a correspondence between two-level programs and one-level programs which take a generalized arrow instance as a distinguished parameter. A translation across this correspondence is possible, and is called a *flattening transformation*.

http://www.eecs.berkeley.edu/Pubs/TechRpts/2014/EECS-2014-130.pdf

http://megacz.com/

https://github.com/procedural/fleet

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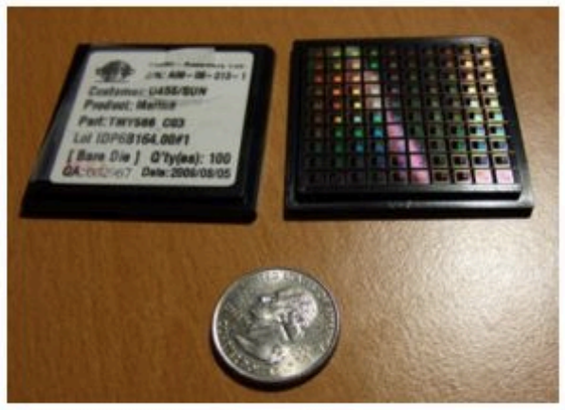
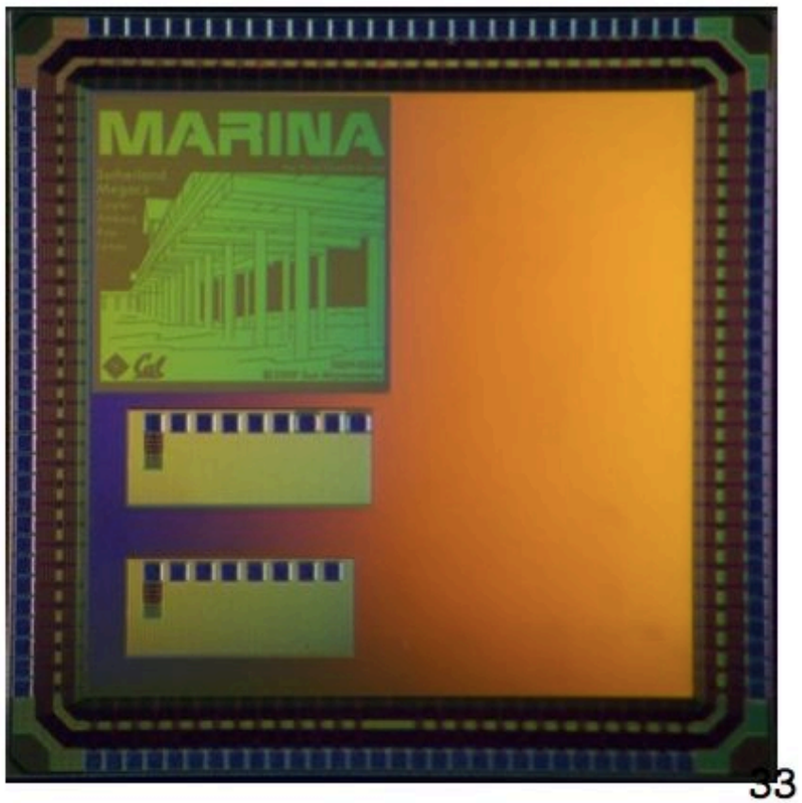
Marina test chip

- Includes earlier 6/4 GasP counter design, 90nm
  - >6 bits wide
  - >Fully interfaced to Dock





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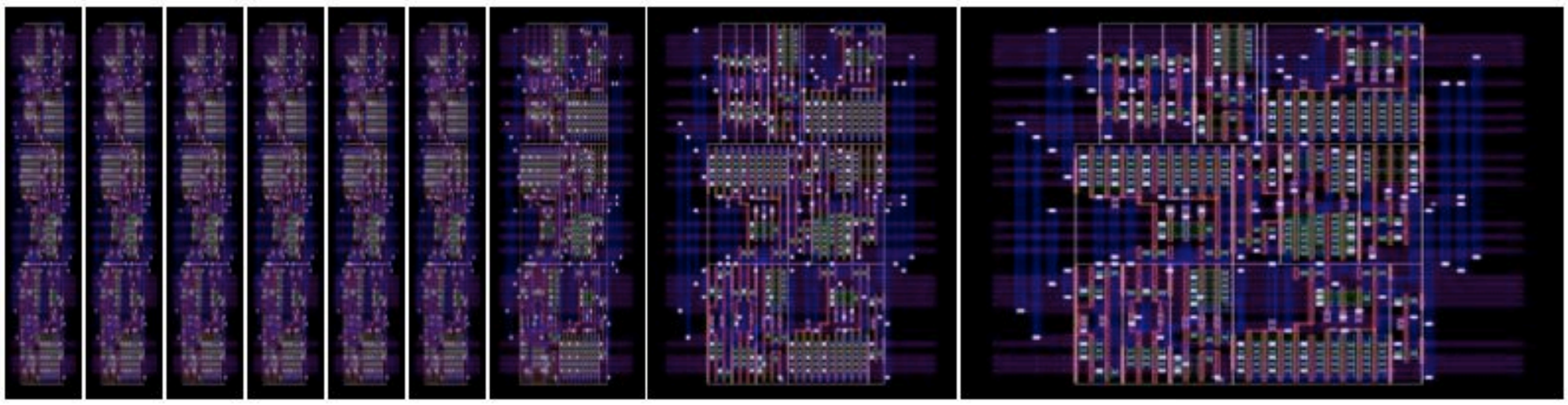
The Power of Asynchrony

- Different bits need not be sized the same!
  - >No clock constraint to meet, so:
    - >Size the least significant bits very large (fast, lots of area)
    - >Size the more significant bits exponentially smaller
      - – Down to min-size
      - – Big area savings in large (>=64bit) counters



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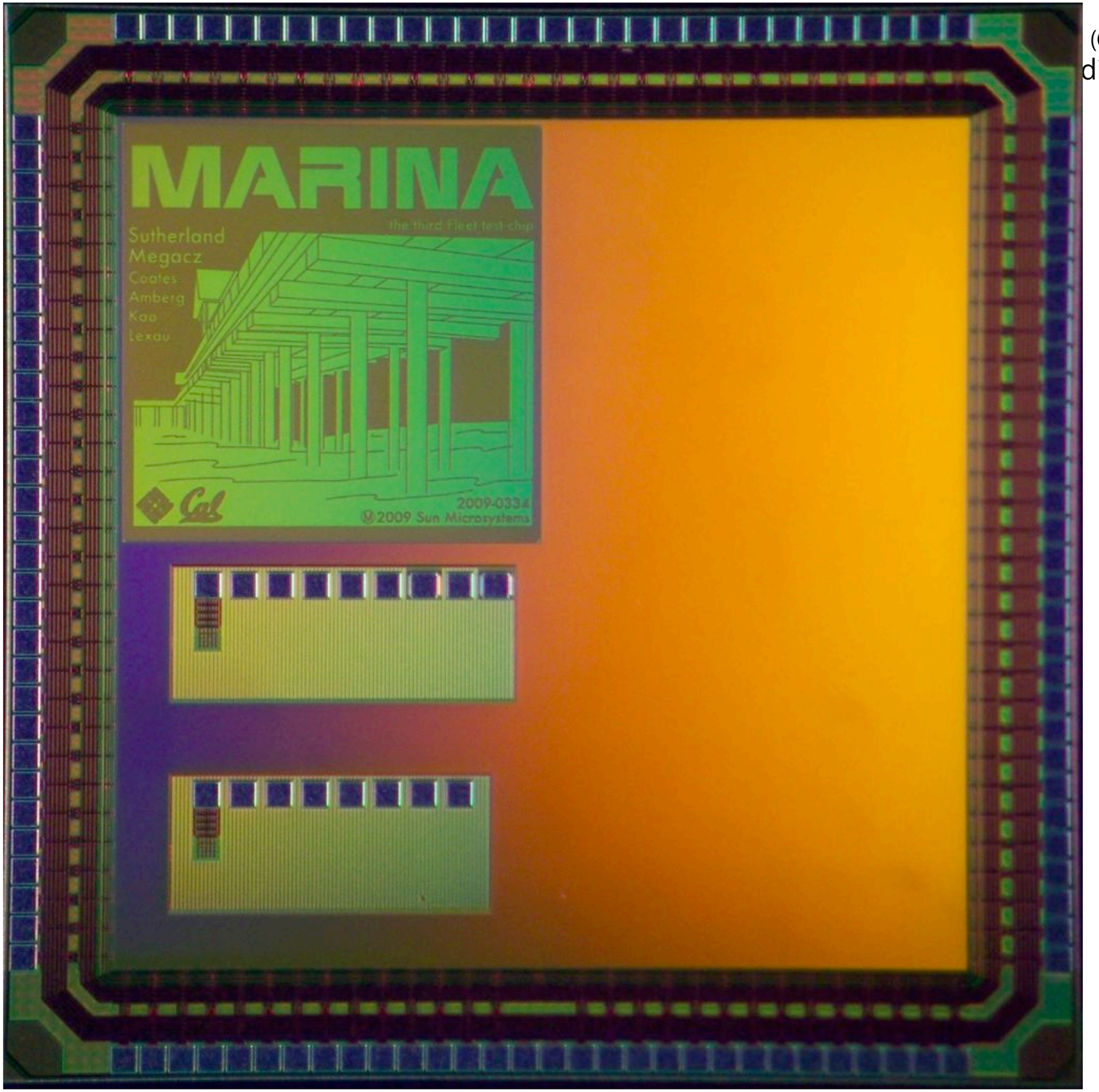

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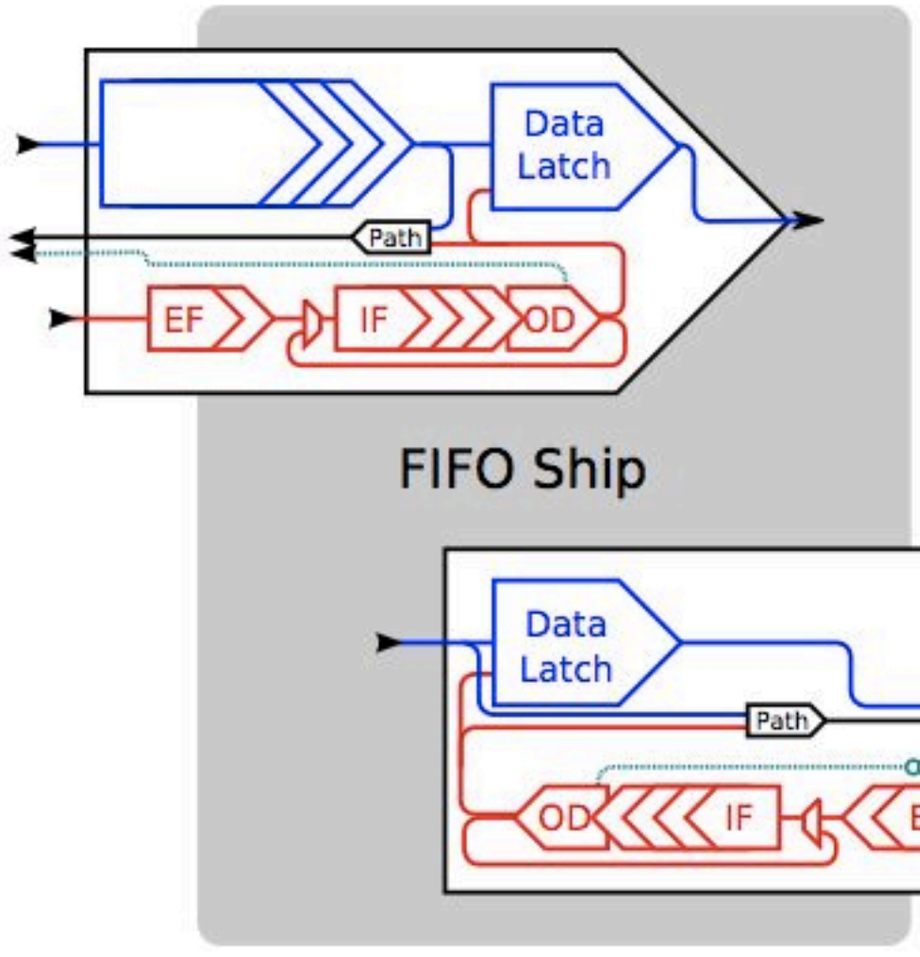

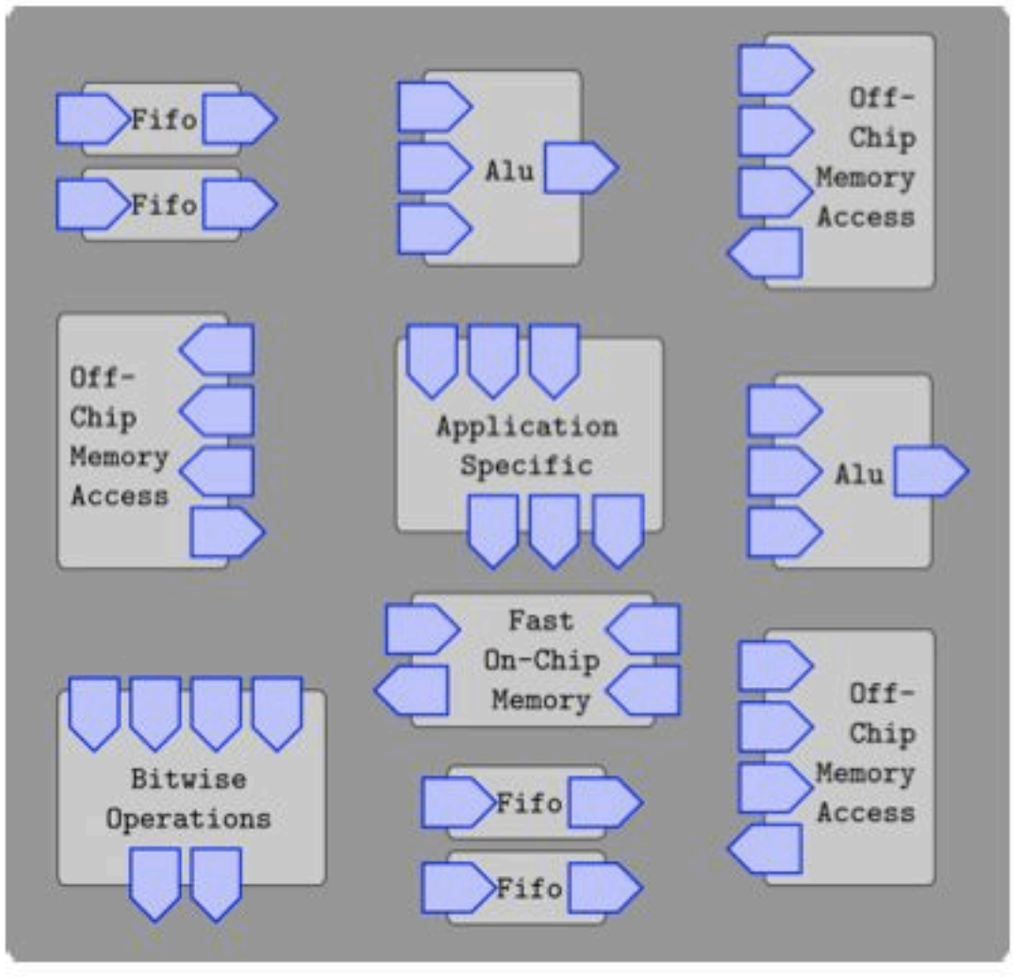

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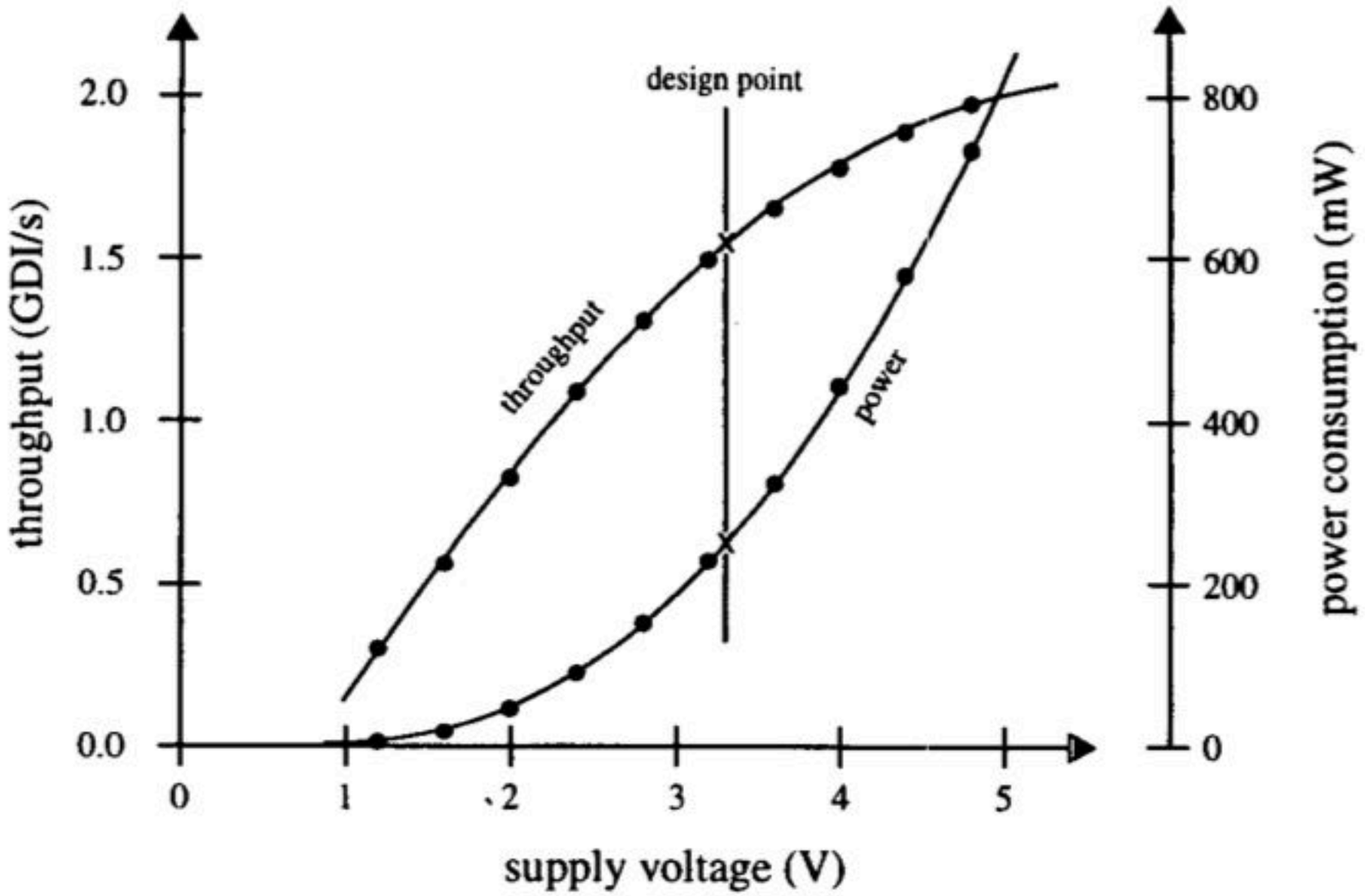

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Radical Atoms

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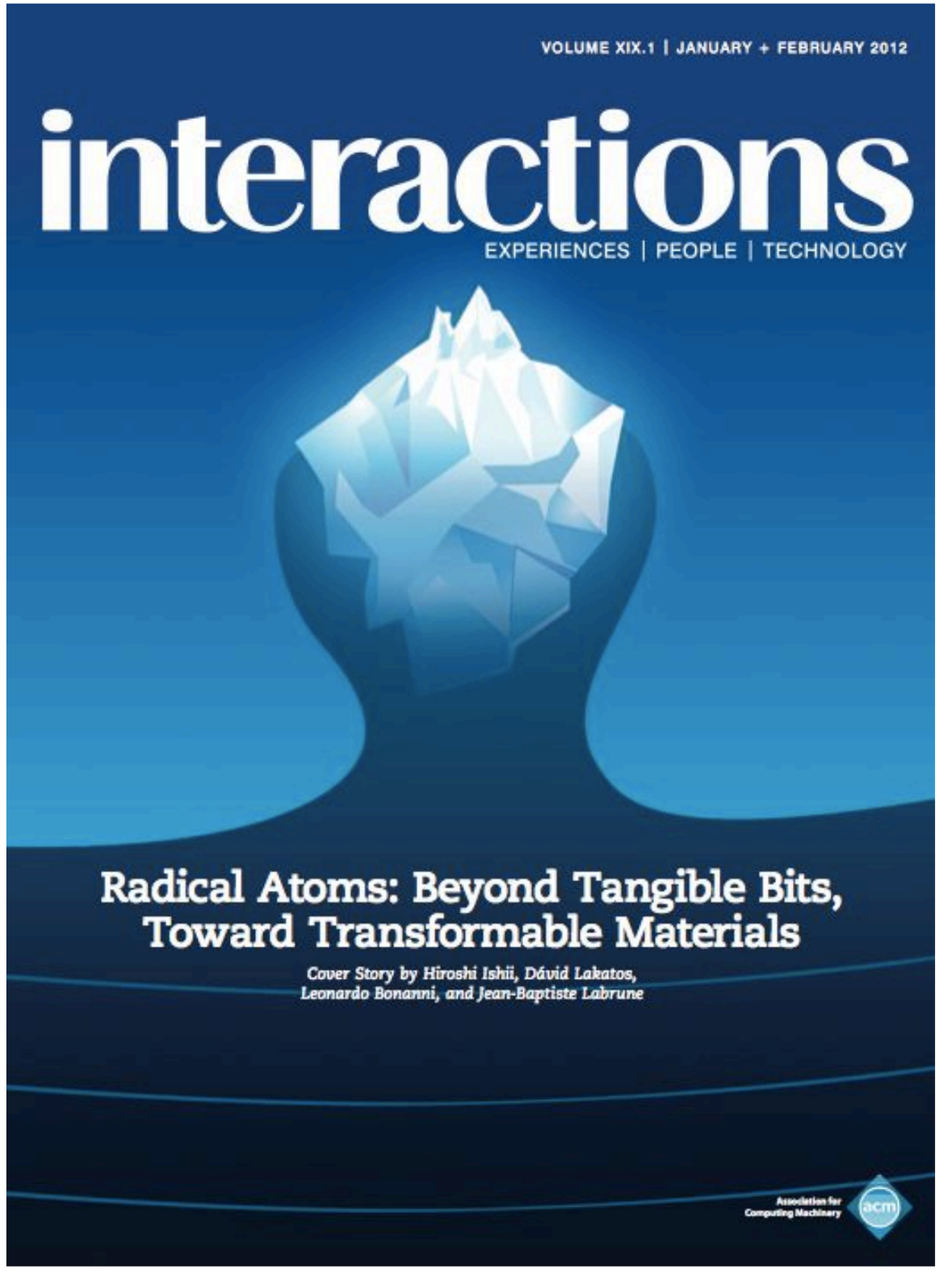
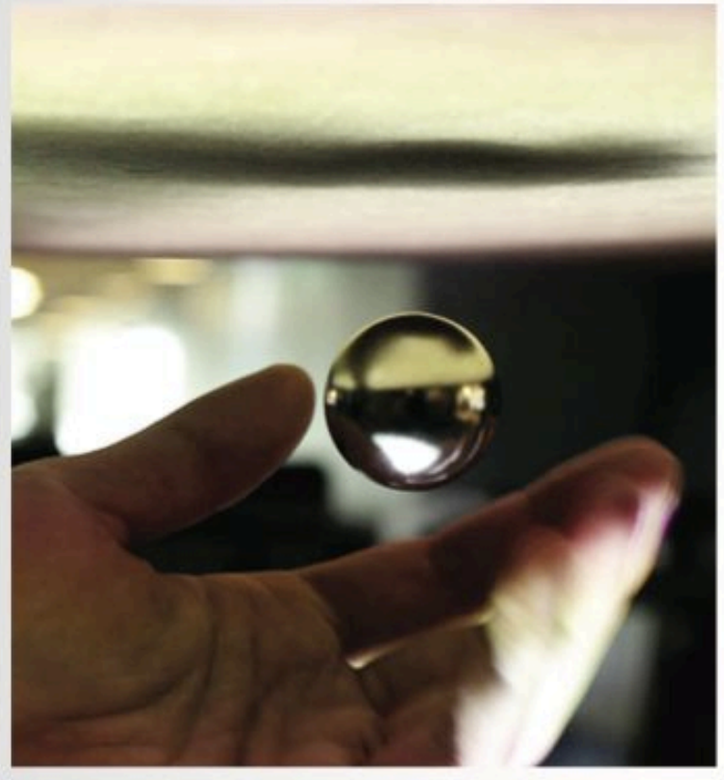
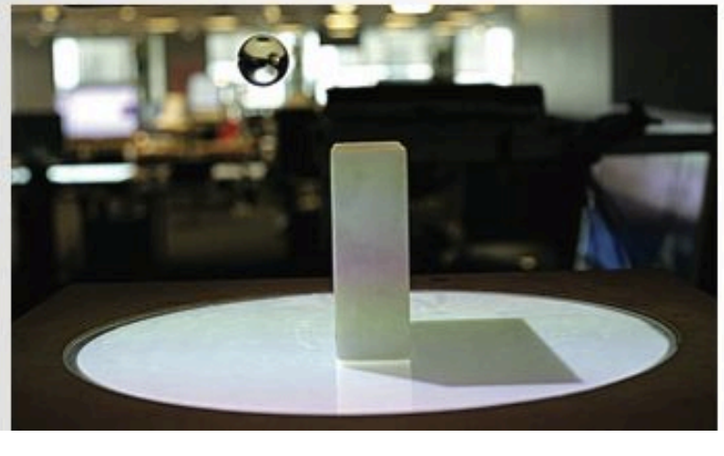
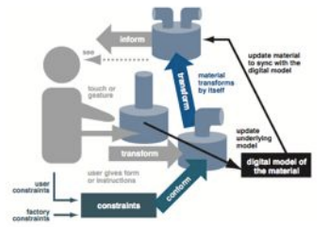
Programmable Matter **Design**



ZeroN is an anti-gravity interaction element that can be levitated and moved freely by a computer in 3-D space, seemingly unconstrained by gravity. A ZeroN in movement can represent a sun that casts the digital shadow of physical objects or a planet orbiting based on a computer simulation. The user can place or move the ZeroN in the mid-air 3-D space just as they can place and interact with objects on surfaces. Removing gravity from tangible interaction, the ZeroN project explores how altering the fundamental rule of the physical world will transform interaction between humans and materials in the future.







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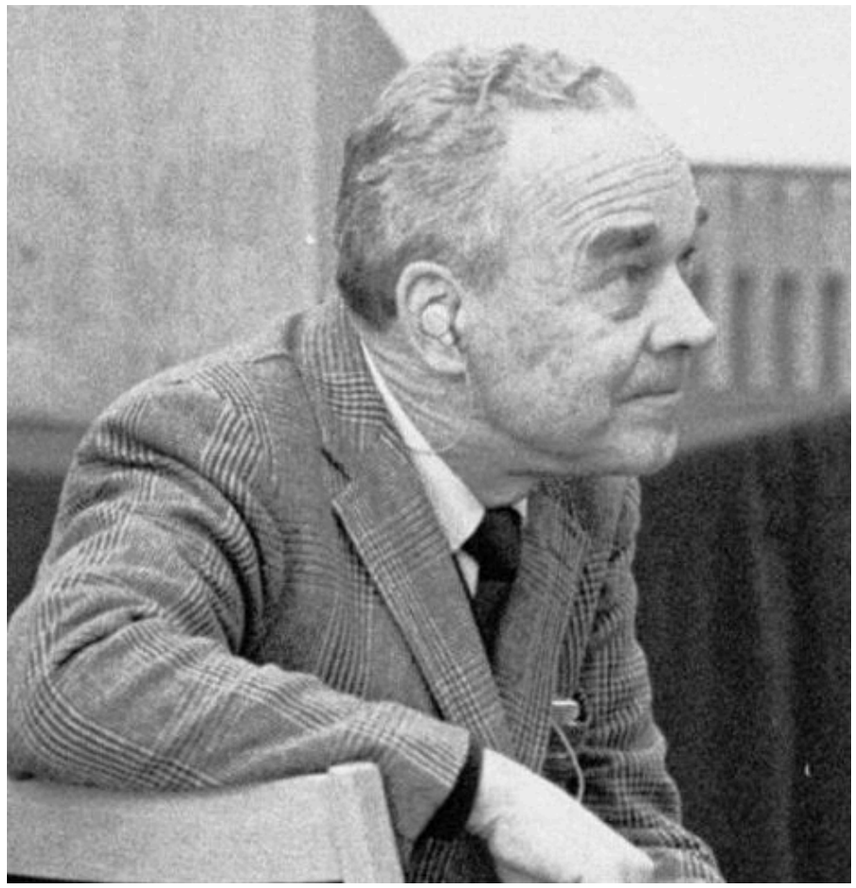
Rethinking Gibson



Gibson's Affordances

James G. Greeno

Gibson developed an interactionist view of perception and action that focused on information that is available in the environment. He thereby rejected the still-prevalent framing assumption of factoring external–physical and internal–mental processes. The interactionist alternative, which focuses on processes of agent-situation interactions, is taken in ecological psychology as well as in recent research on conversational communication, research on complex, socially organized activity, and philosophical situation theory. The concepts of *affordance* and *ability* are key ideas in an interactionist account. In situation theory, abilities in activity depend on *attunements to constraints*, and affordances for an agent can be understood as conditions in the environment for constraints to which the agent is attuned. This broad view of affordances includes affordances that are recognized as well as affordances that are perceived directly.

http://ecologylab.cse.tamu.edu/courses/physicalInterfaces/hostedMaterials/gibsonAffordances.pdf

- Affordances AND Abilities
- From perceived Affordances of what «we» as human can do towards perceived Affordances + perceived Abilities (term present in Gibson) of what «it» (matter), «they» (objects) can do to us

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Affordances StatoDynamic Abilities

Transparent <---> Opaque

Reflective <---> Absorptive

Electrically Conductive <---> Electrically Insulative

Thermally Conductive <---> Thermally Insulative

Magnetic <---> Nonmagnetic

Flexible <---> Rigid

Luminous <---> Nonluminous

Elastic <---> NonElastic

Viscous <---> Fluid

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Affordances to Abilities

- Shape-shifting
- Color-changing
- Rapid solidification
- Rapid sublimation
- Antigravitationnal
- Capillarity
- Tribocharging
- Jamming

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Programmable Matter Artefacts

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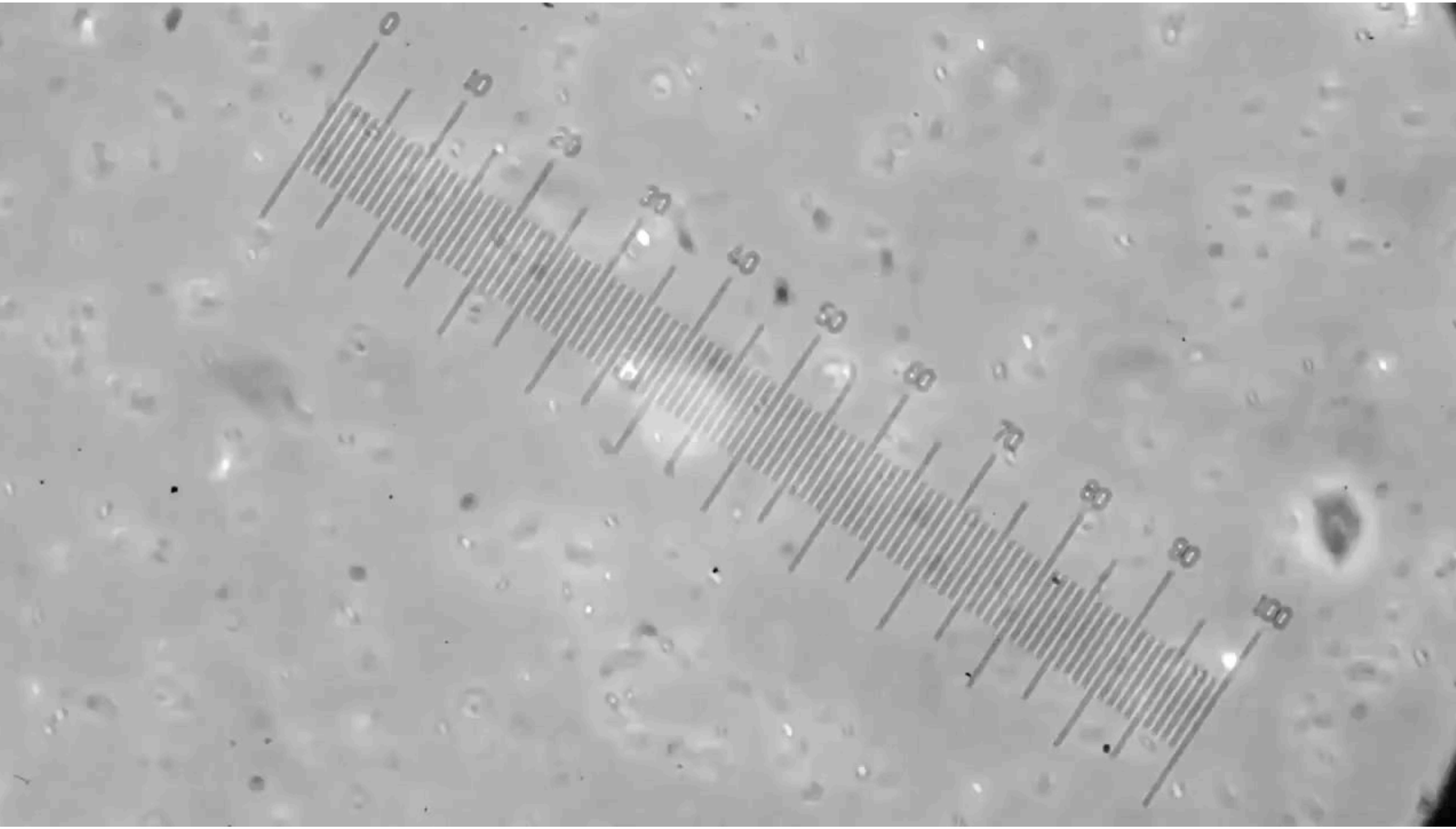

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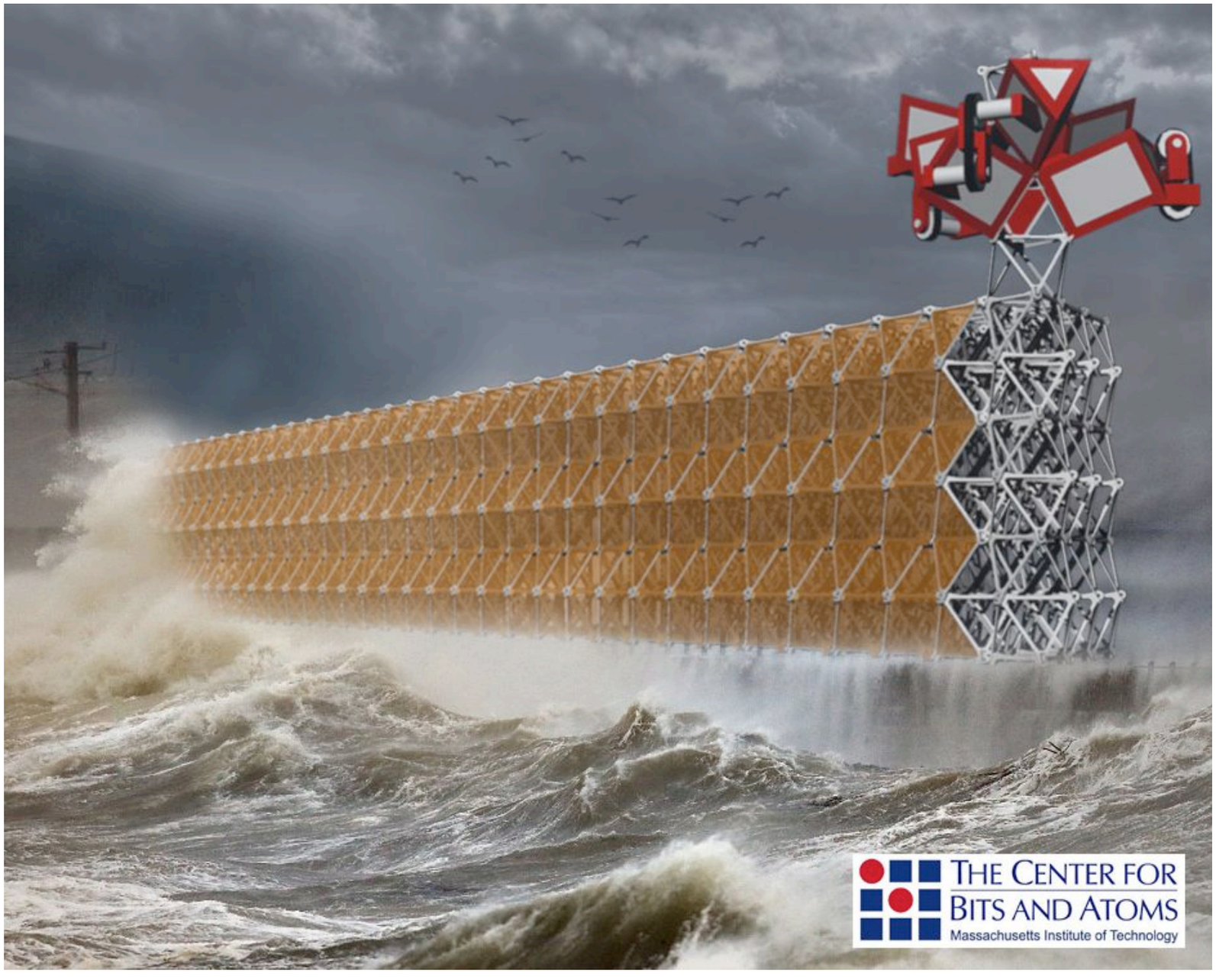
Programmable Matter Vision



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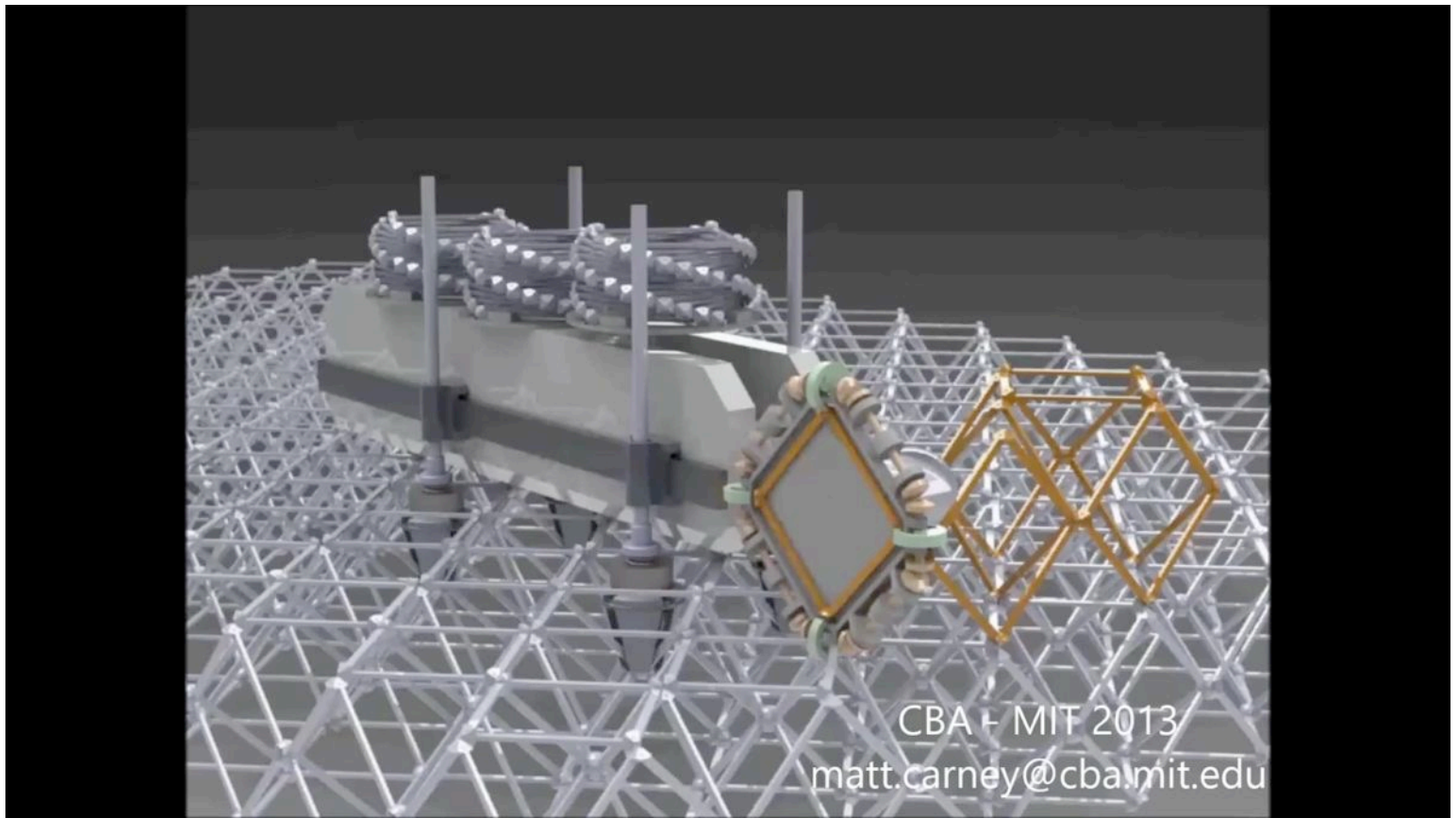

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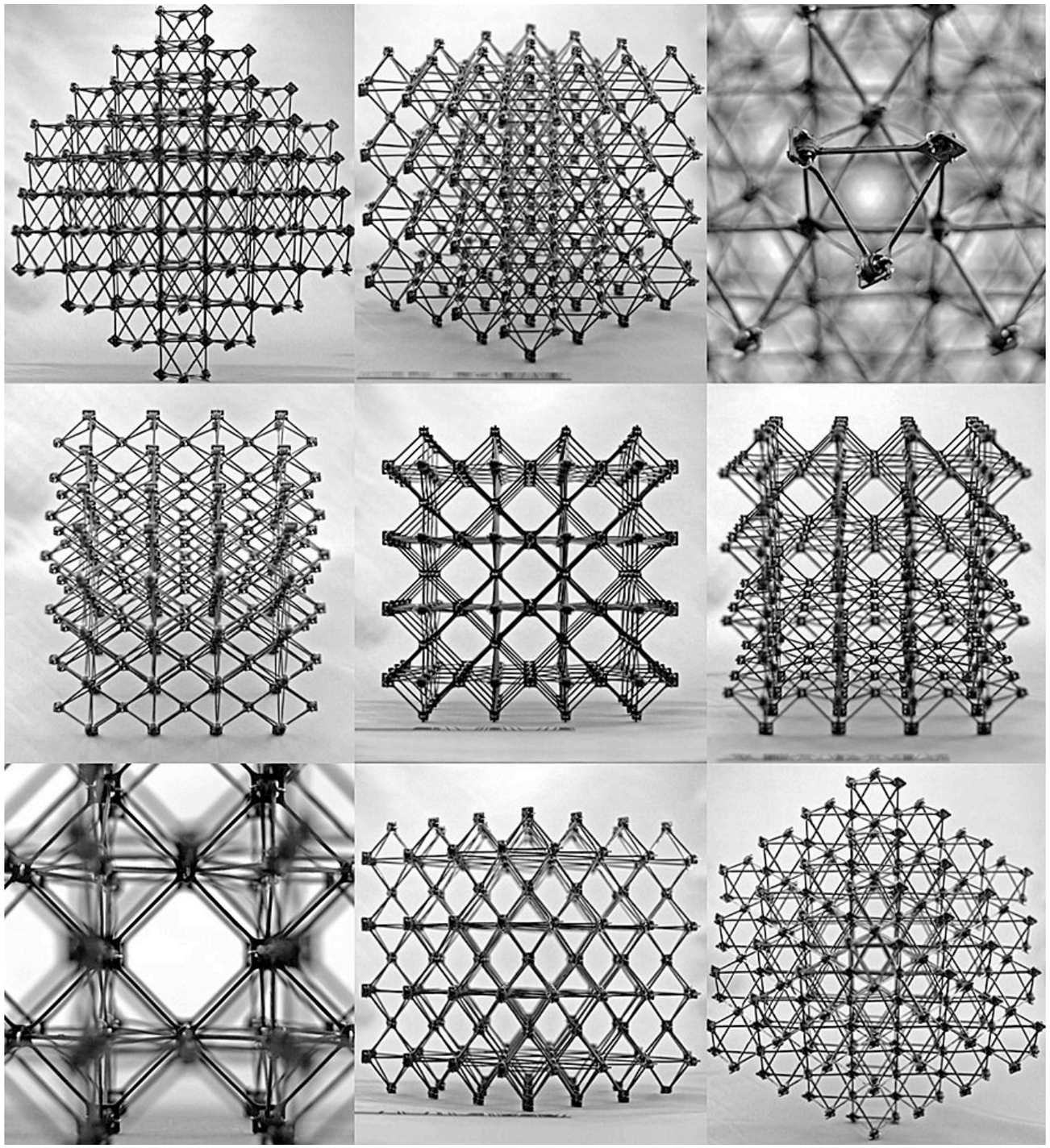

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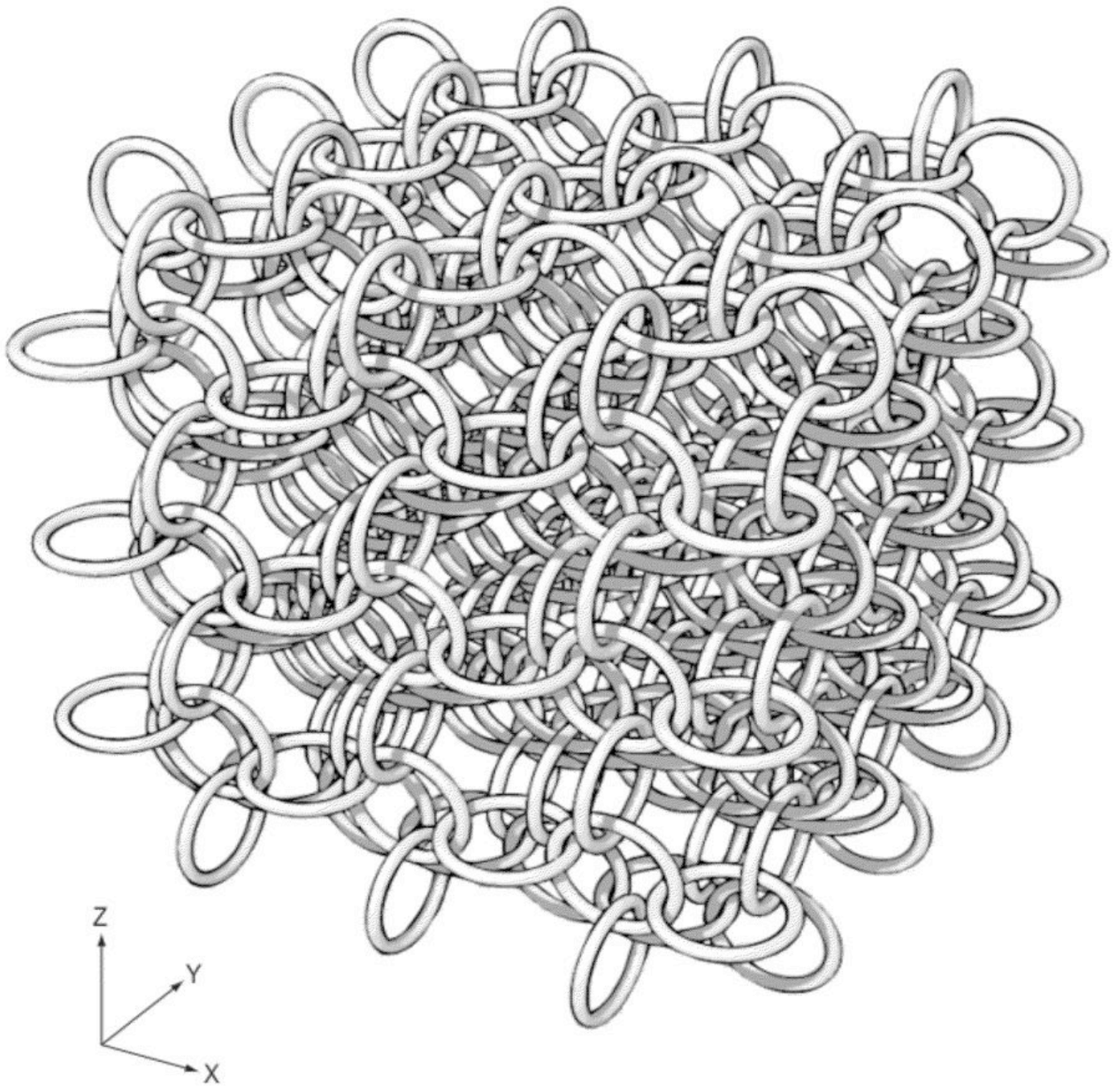

FIG. 1D

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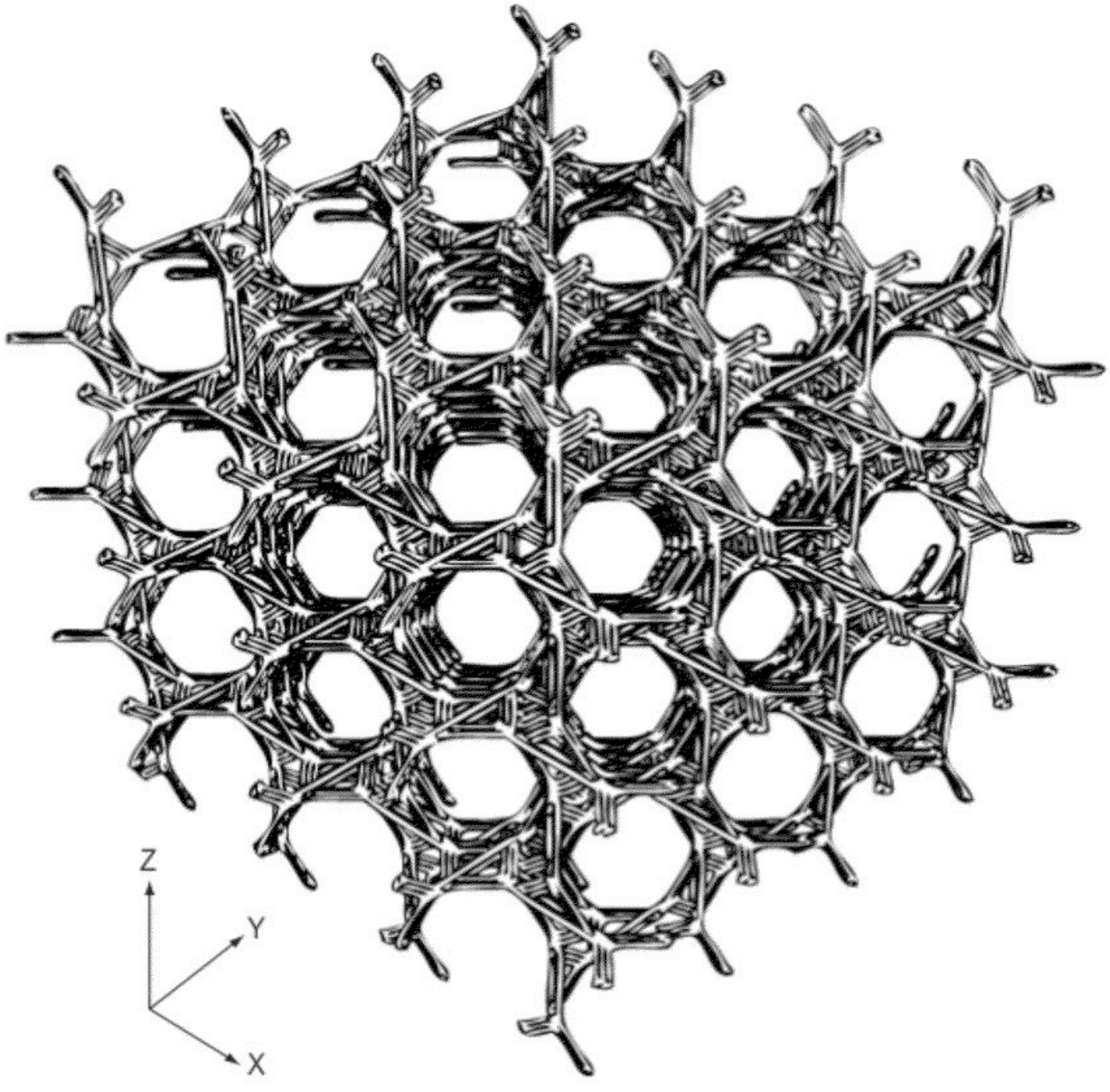

FIG. 9B

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Exaptation

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FeedForward

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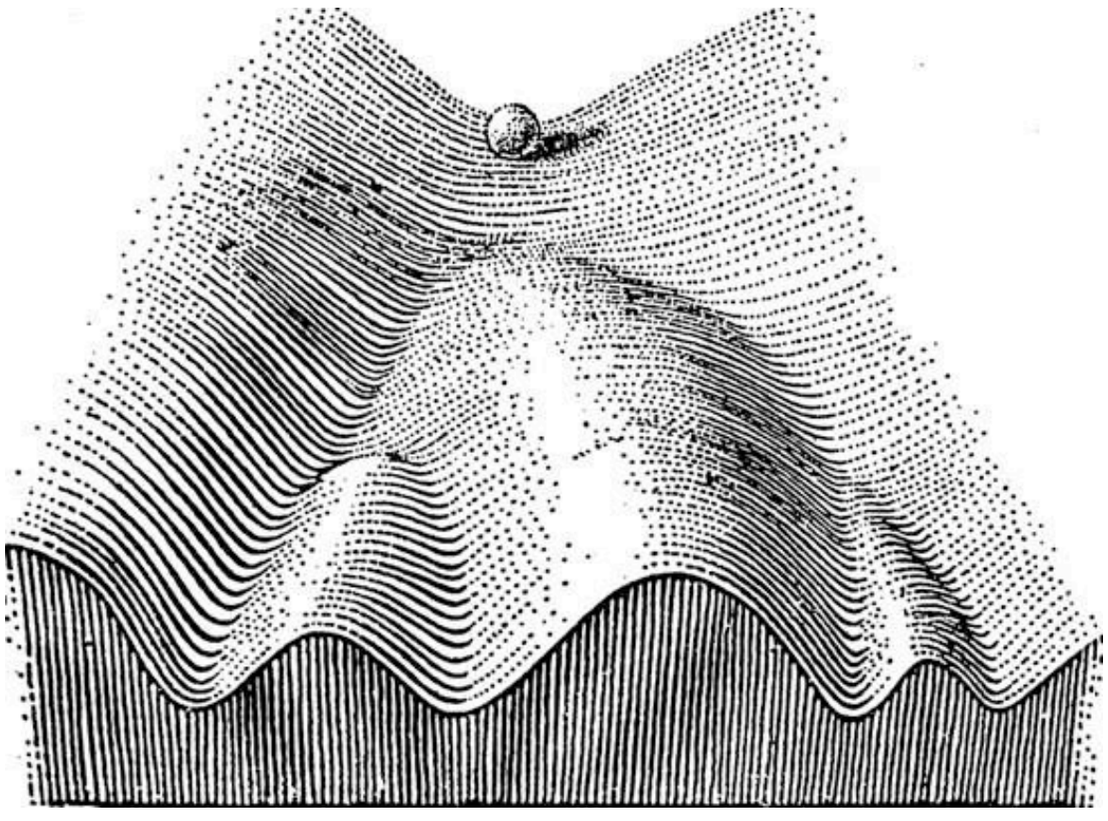
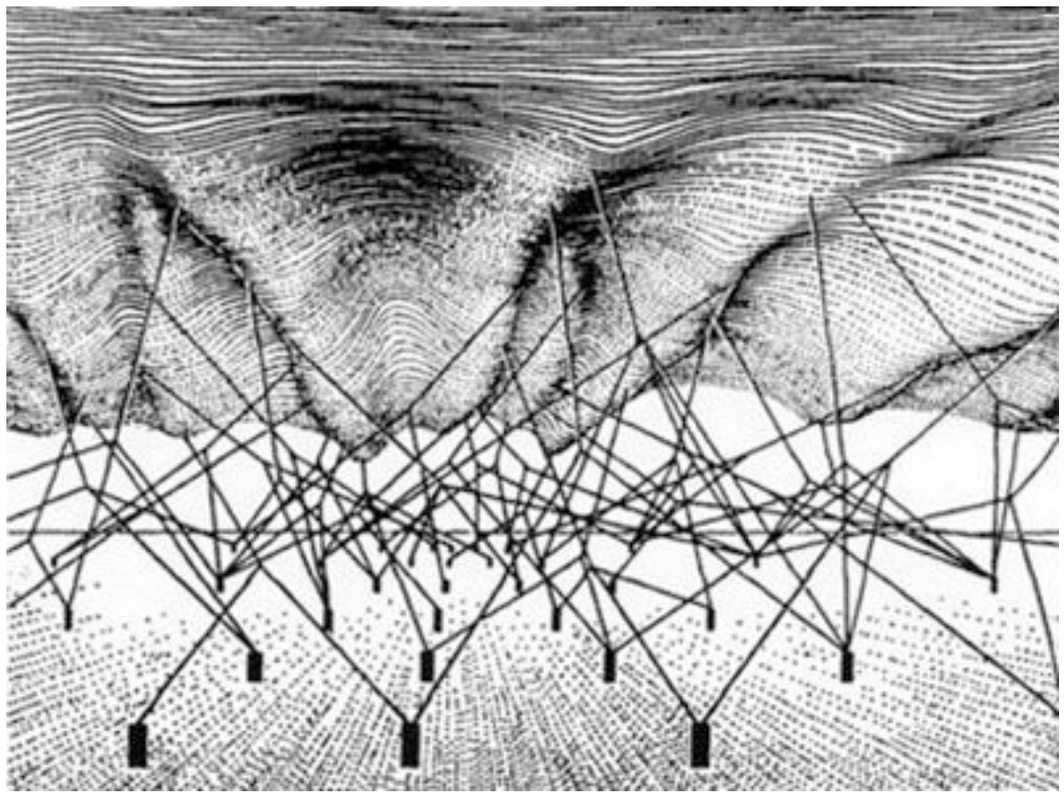
Epigenetic Landscape

C.H. Waddington





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Gould & Vrba

- Exaptation: A character, **previously shaped by natural selection** for a particular function (an adaptation), is coopted for a new use—cooptation. (2) A character **whose origin cannot be ascribed to the direct action of natural selection** (a nonaptation), is coopted for a current use—cooptation.

Gould and Vrba (1982, Table 1)

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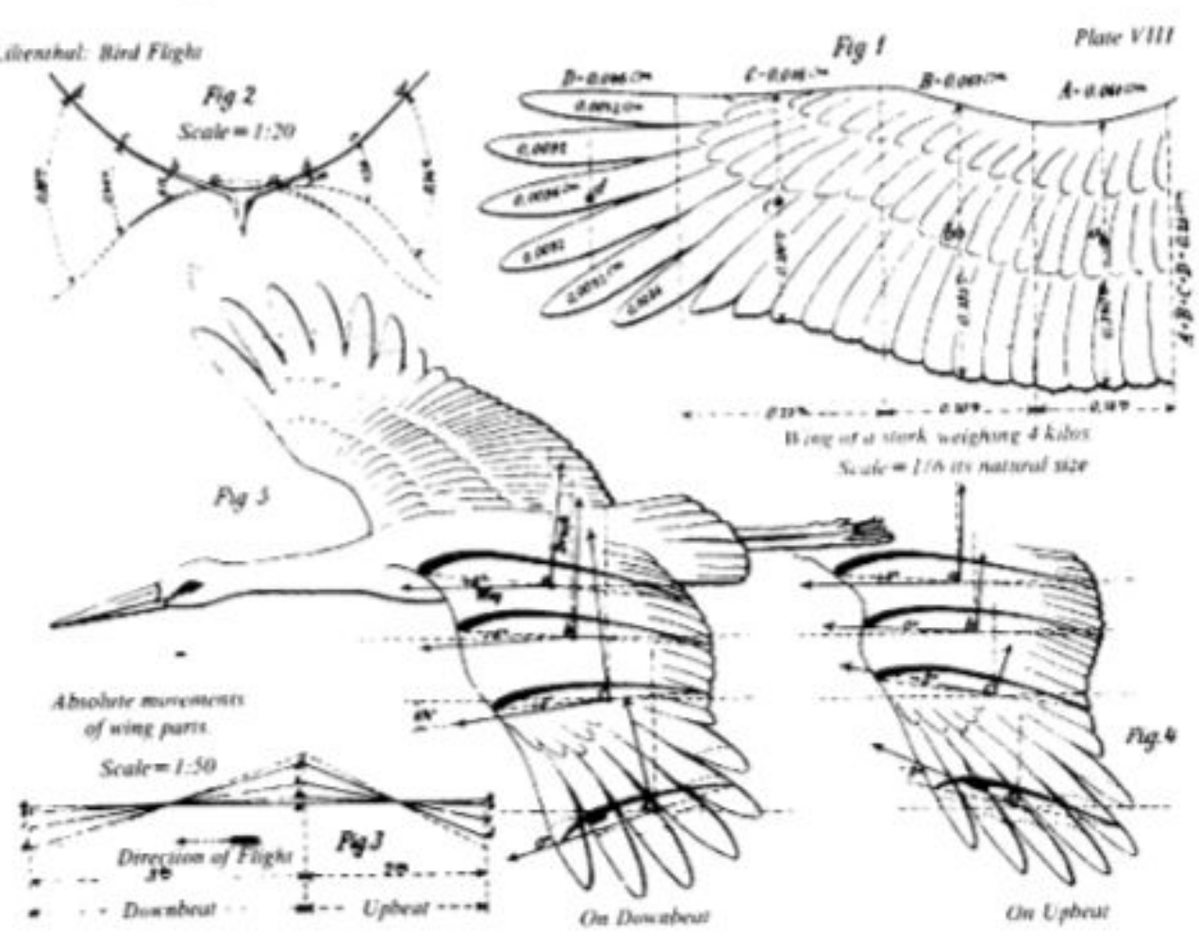
Exaptation

- Flying is an exaptation
- A secondary adaptation from thermic regulation evolution



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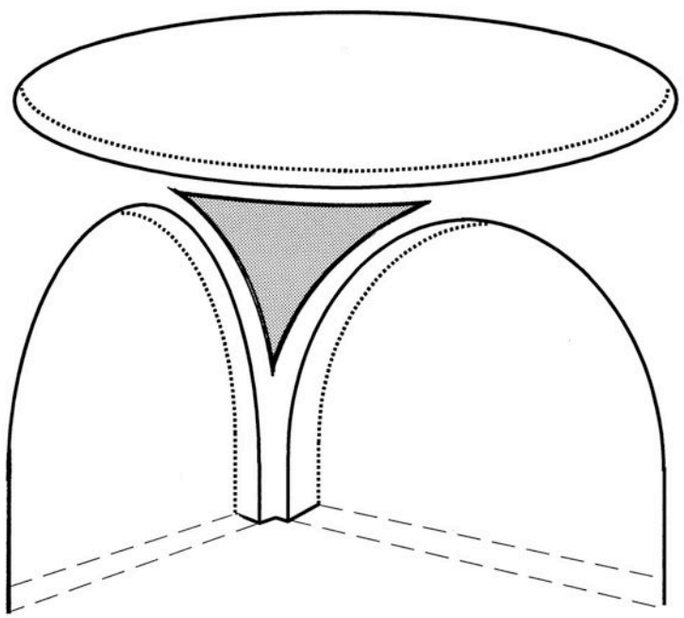
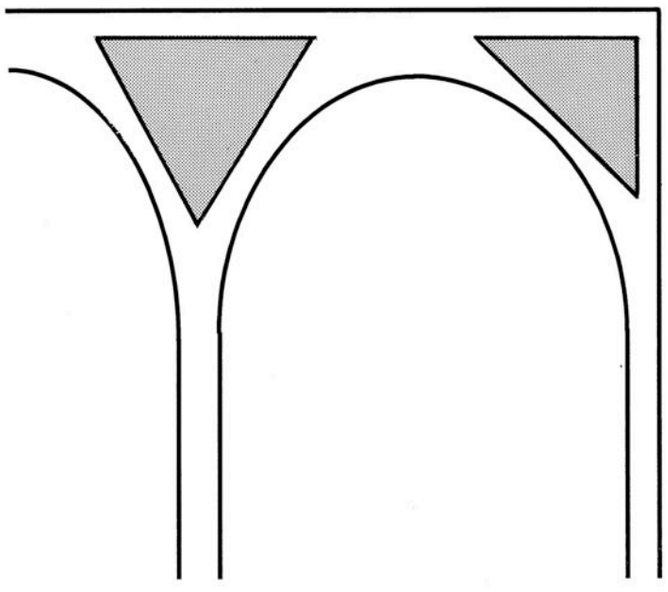
Spandrels





- Lewontin and Gould (1979)
  - The Spandrels of San Marco and the Panglossian Paradigm:
    A Critique of the Adaptationist Programme
  - http://rspb.royalsocietypublishing.org/content/205/1161/581
- Gould (1997)
  - The exaptive excellence of spandrels as a term and prototype
  - http://www.pnas.org/content/94/20/10750.abstract?sid=c80b8cc0-4a00-4bb6-ae92-3e9897ef5da5

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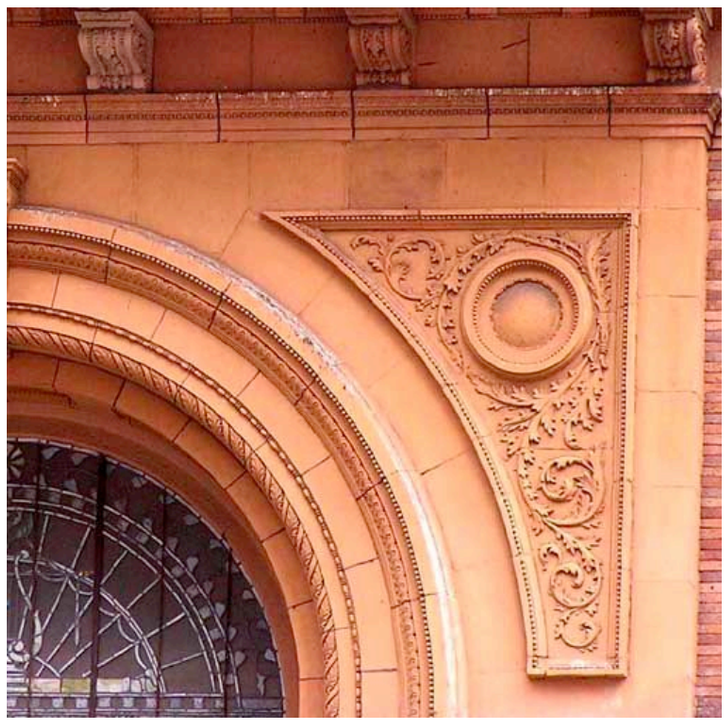
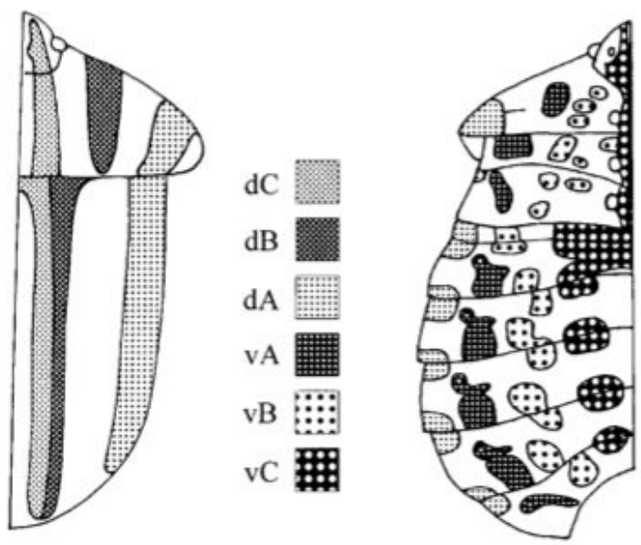
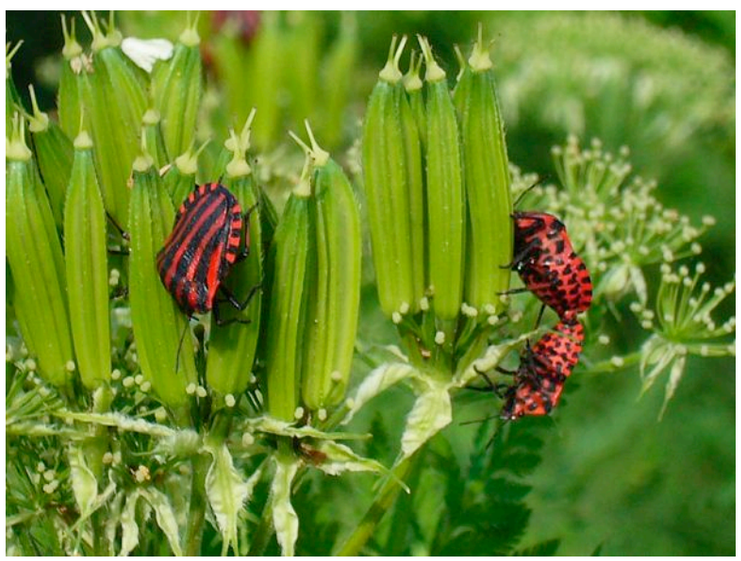
Spandrels

- By-Product of Functional evolution, or design iteration
- Morphogenetic By-Products







Dorsoventral Pattern Formation in Graphosoma Lineatum

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Technological Exaptation

http://web.media.mit.edu/~labrune/talks/ExaptationMIT.pdf

- Functions
- By-Products
- Ambiguity and Paradox of Openess
- Designing vs Non-design

http://www.arborsmith.com/

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Neo-Cybernetics

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Cybernetics ...

"the science and art of understanding"... - Humberto Maturana

"interfaces hard competence with the hard problems of the soft sciences" - Heinz von Foerster

AMERICAN SOCIETY FOR CYBERNETICS

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It is with great sorrow that we have to report to members the death of ASC President **Ranulph Glanville**.

Ranulph Glanville died on December 20th 2014.

Here is an obituary on the website of the Institute for the Study of Coherence and Emergence, written by Michael Lissack.

ASC Channel on YouTube

ASC's new YouTube video channel is accessible at:

http://www.youtube.com/ascybernetics

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Our Focal Subject: Cybernetics

on the shoulders of giants

Defining 'Cybernetics' | Cybernetics Timeline | Cybernetics' Prehistory

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2nd-Order Cybernetics

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Second order Cybernetics (also known as the Cybernetics of Cybernetics , and the New Cybernetics) was developed between 1968 and 1975 in recognition of the power and consequences of cybernetic examinations of circularity. It is Cybernetics , when Cybernetics is subjected to the critique and the understandings of Cybernetics . It is the Cybernetics in which the role of the observer is appreciated and acknowledged rather than disguised, as had become traditional in western science: and is thus the Cybernetics that considers observing, rather than observed systems.

http://www.facstaff.bucknell.edu/jvt002/BrainMind/Readings/SecondOrderCybernetics.pdf

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There is a precise marker indicating the beginning of this revolution: the first symposium of the newly formed American Society for Cybernetics (ASC), held during the American Association for the Advancement of Science meeting in 1968. In certain respects, this symposium reflects the Macy Conferences: organized by Heinz von Foerster, it was chaired by Warren McCulloch, and the keynote paper, "The Cybernetics of Cybernetics" , was given by Margaret Mead. It seems the title and topic of the paper were given to Mead by von Foerster, and reflected his preoccupations more than Meads.

The paper, displaying a remarkably ecological tone, concerns " Cybernetics as a way of looking at things and as a language for expressing what one sees", and, in its conclusion, asks "Why cant we look at this society [the ASC] systematically as a system with certain requirements, certain possibilities of growth, certain constraints to some of which this society is to be responsive?"

http://www.facstaff.bucknell.edu/jvt002/BrainMind/Readings/SecondOrderCybernetics.pdf

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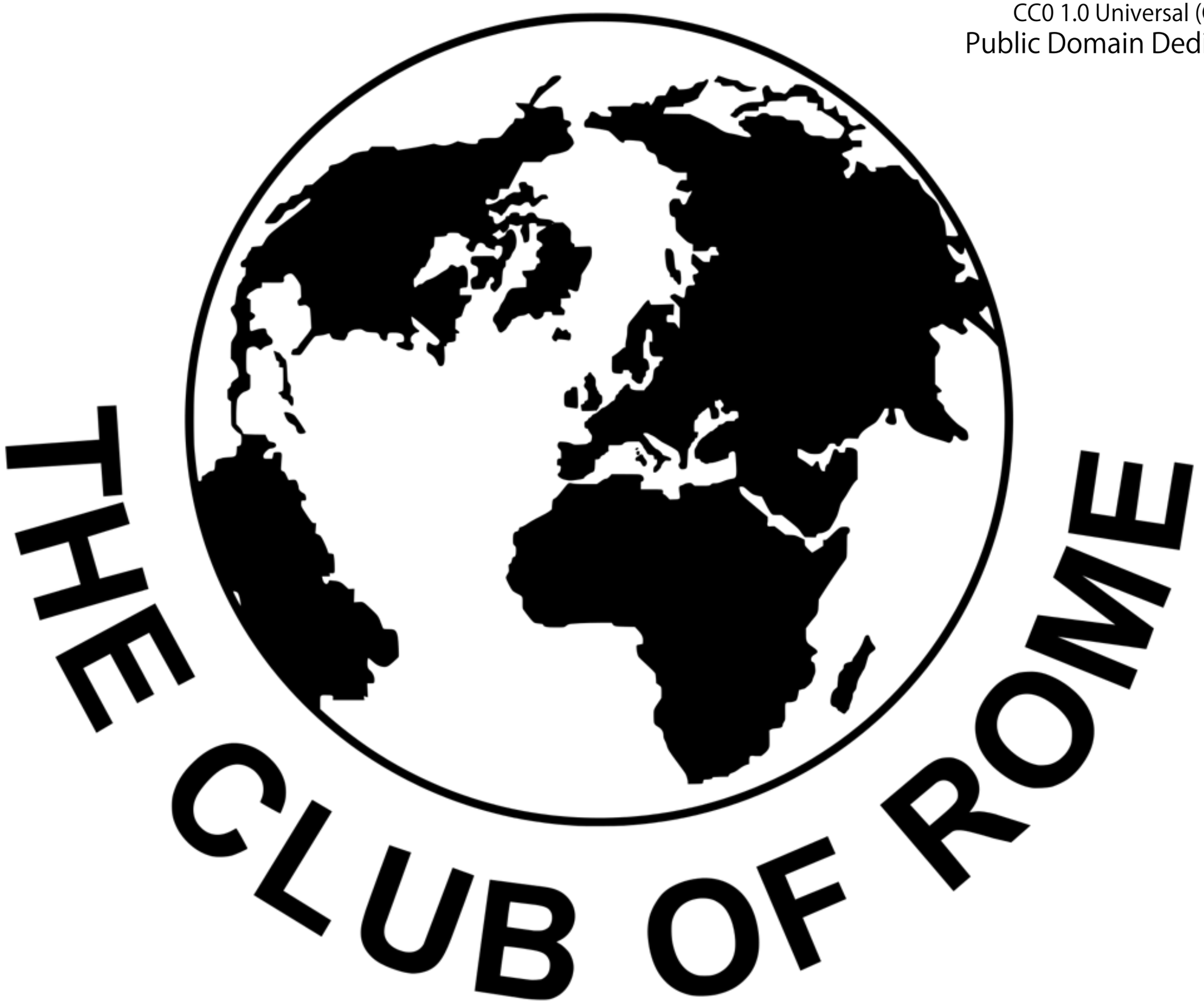

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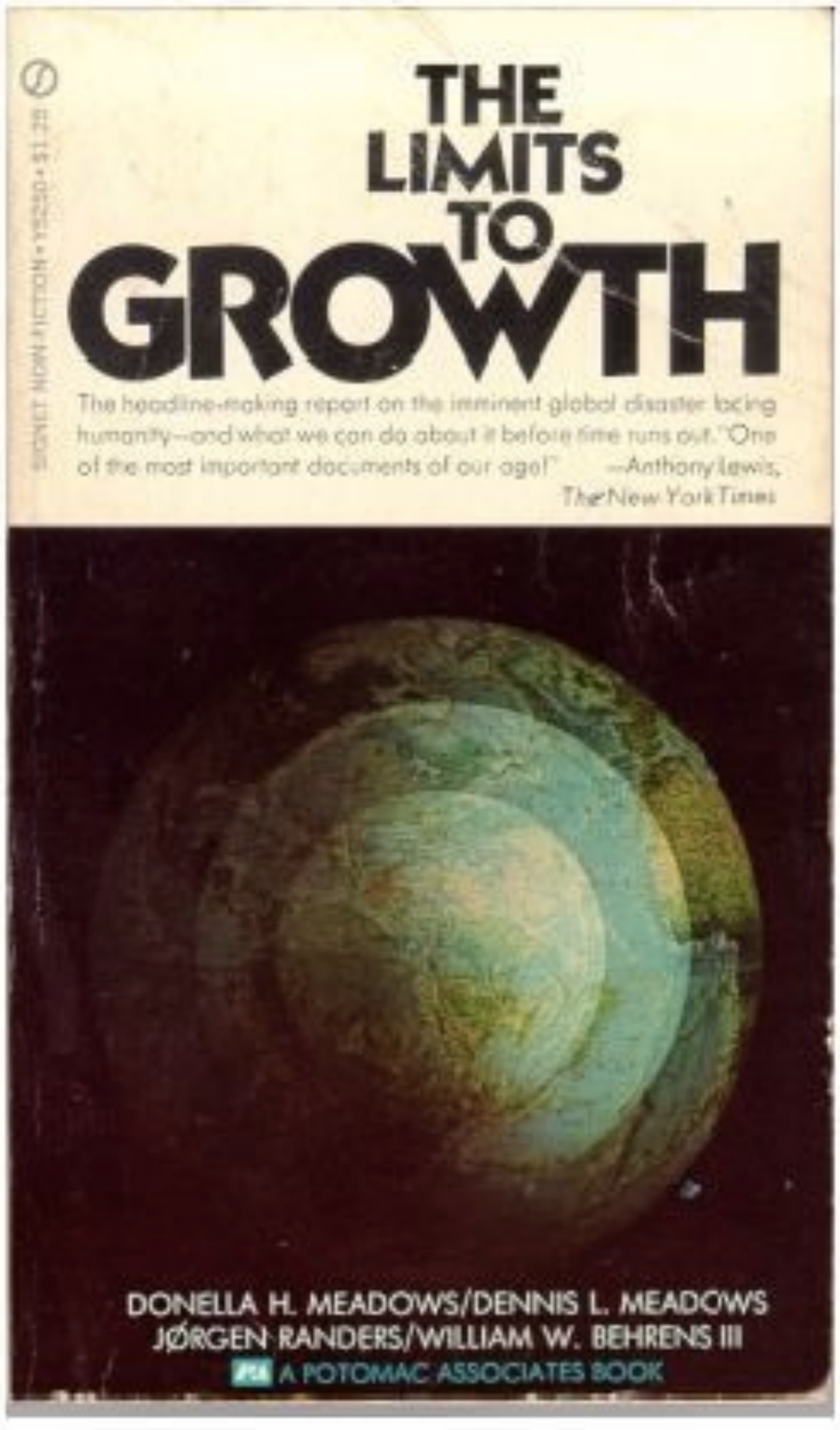

https://libraries.mit.edu/archives/exhibits/energy/index.html

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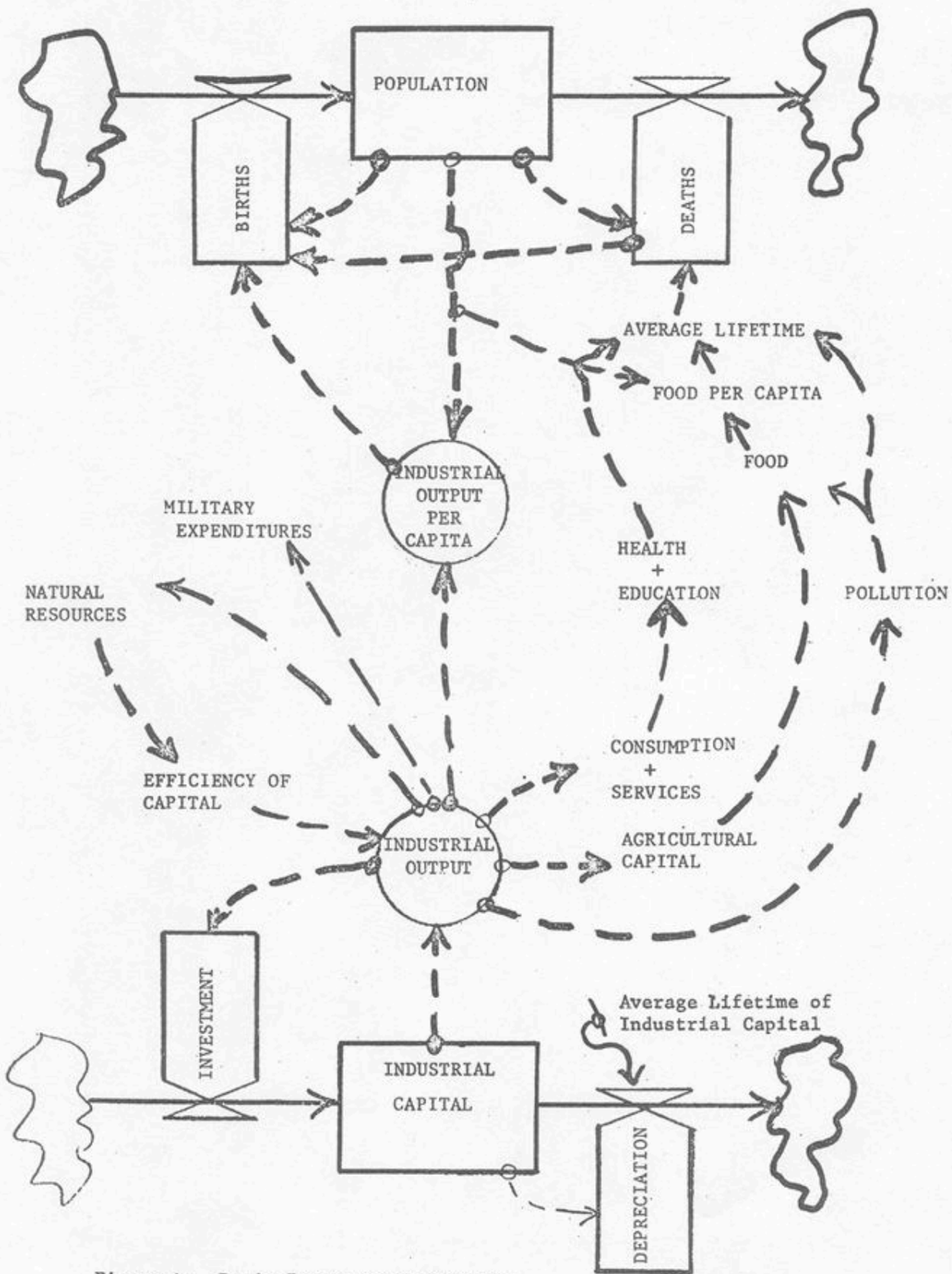

Figure 4: Basic Interactions Between Population Growth and Capital Accumulation

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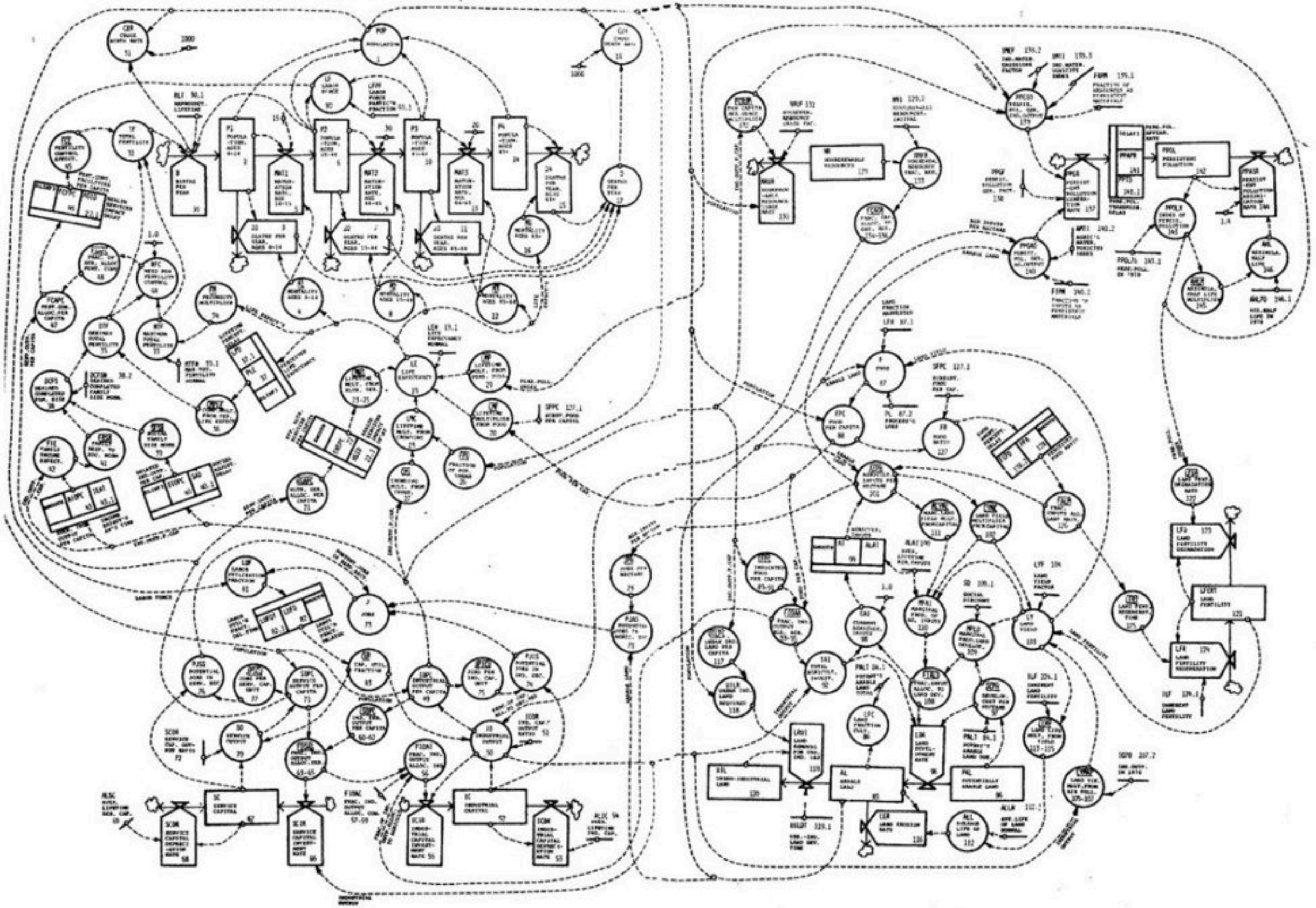

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Complexity

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Ernst Haeckel

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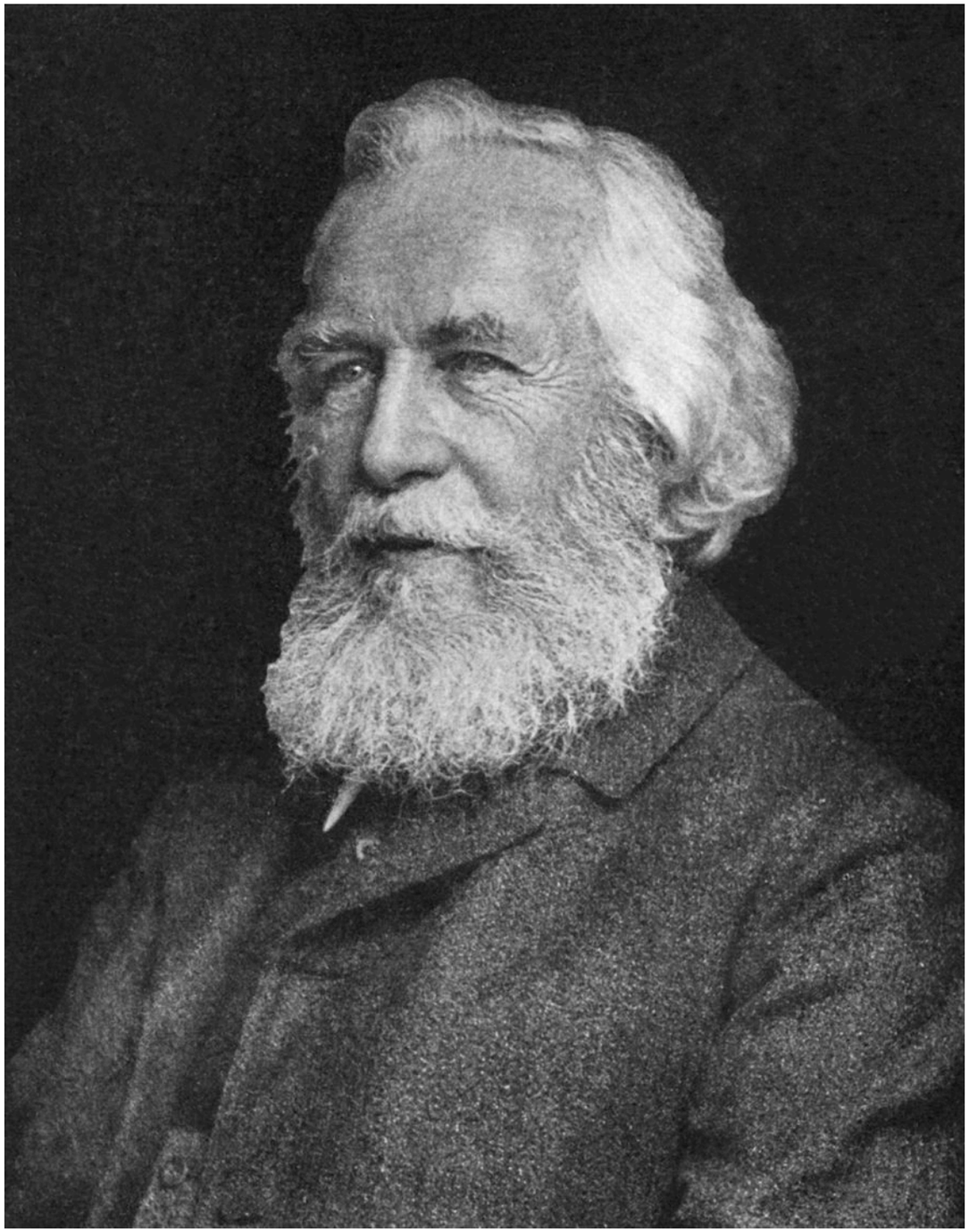

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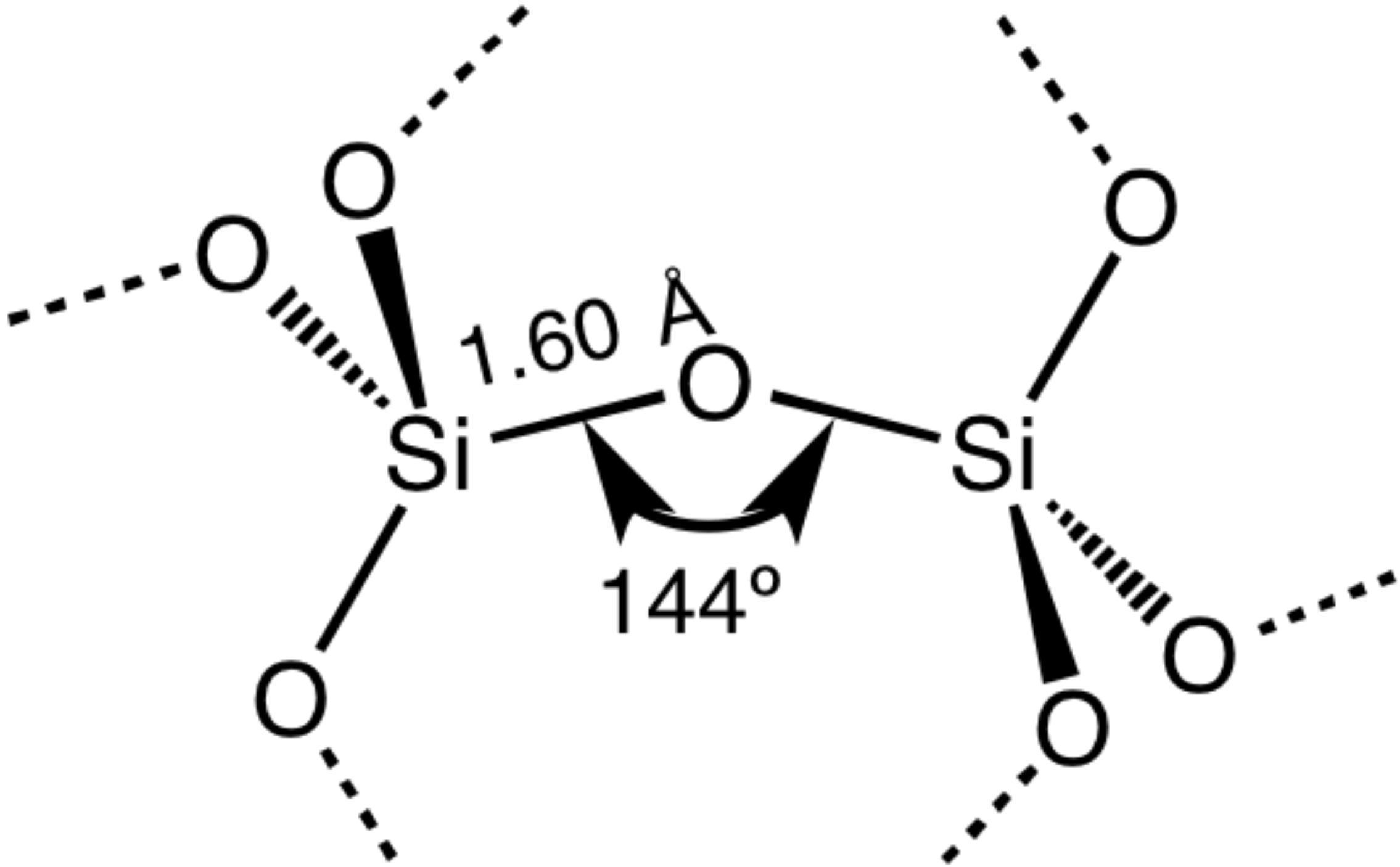

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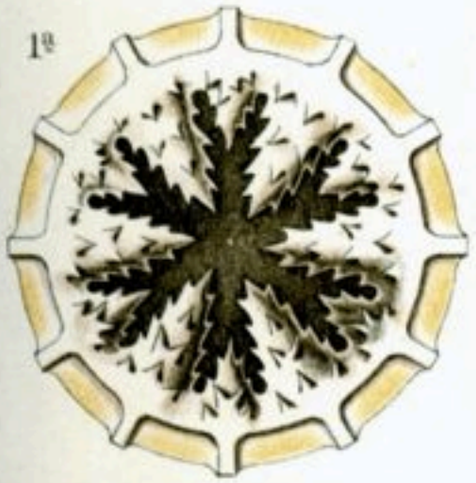

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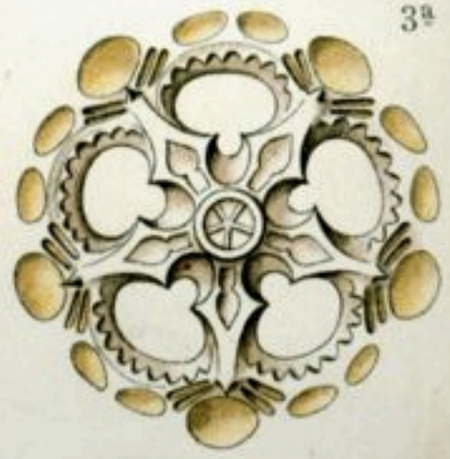

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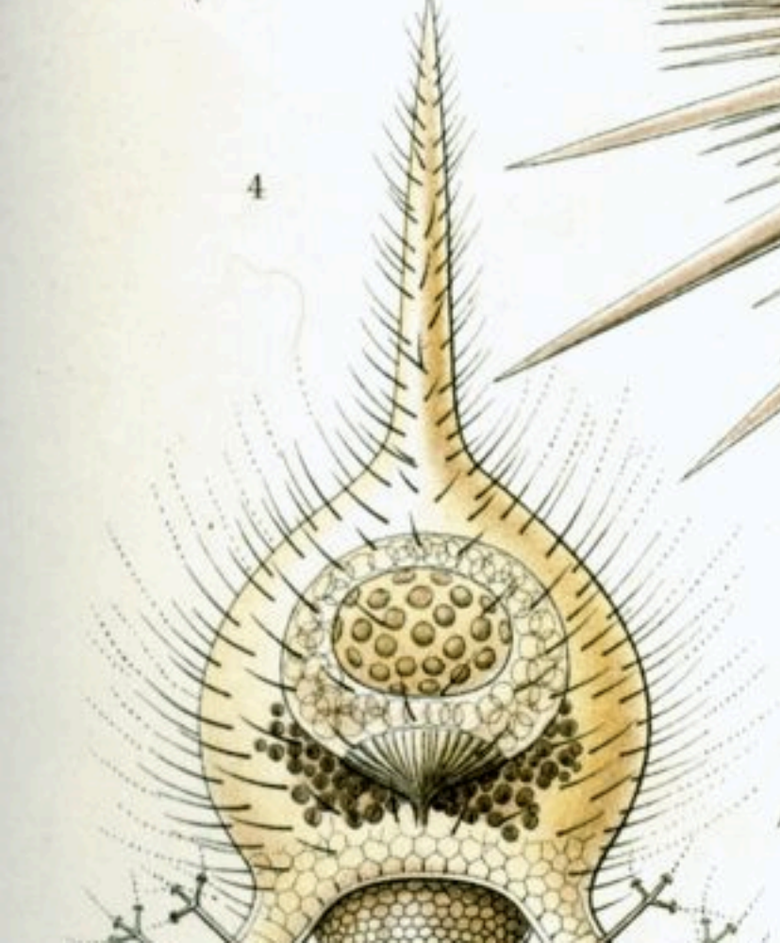

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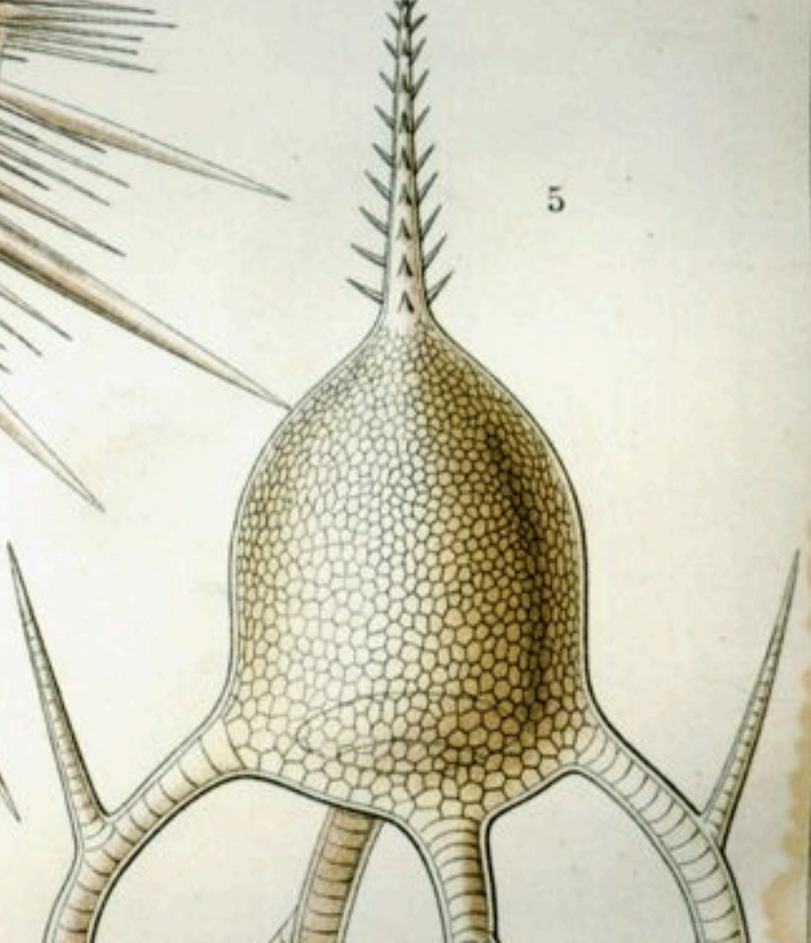

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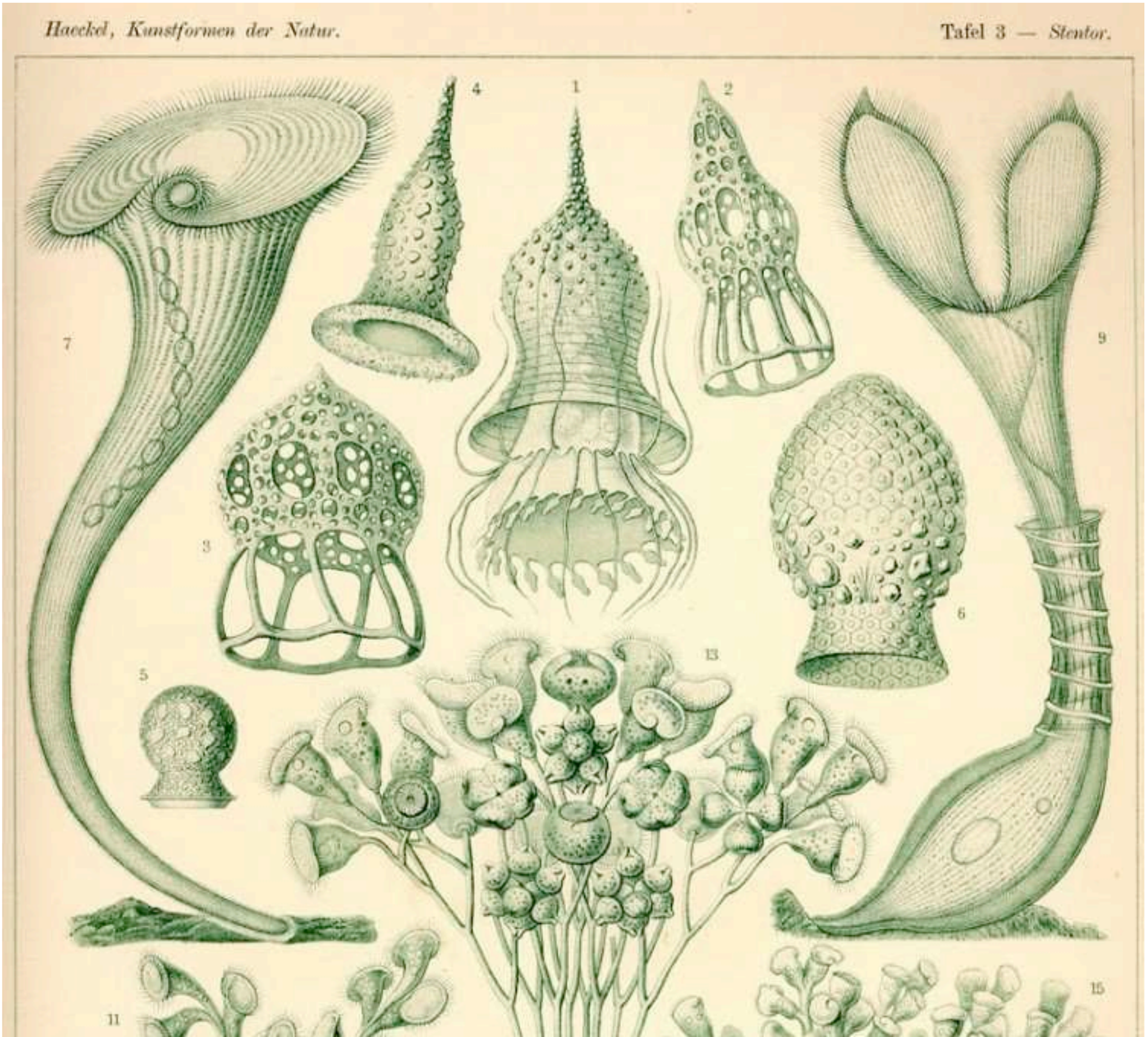

Vorticella campanula (stalked cup shaped organisms) attached to a green plant

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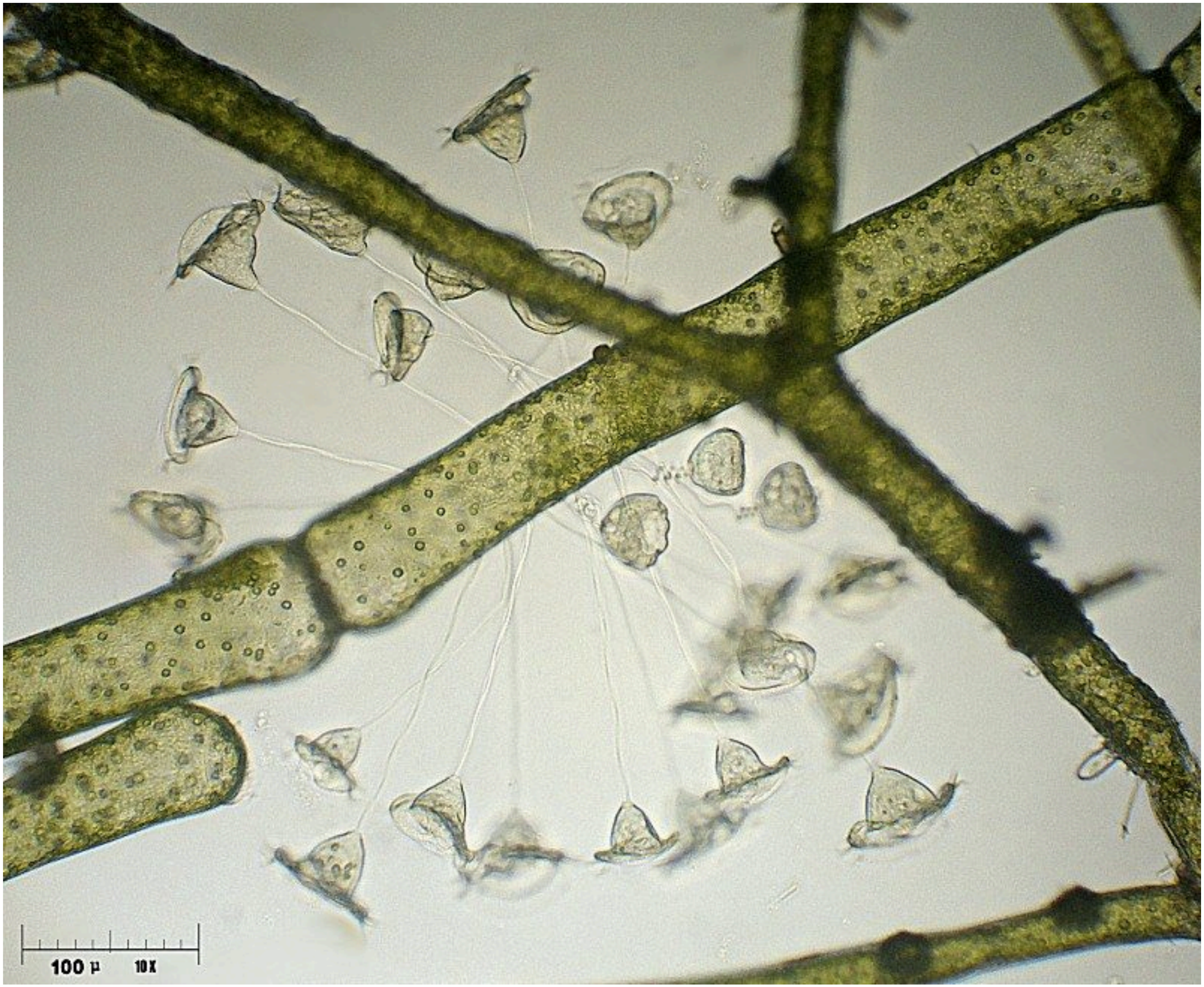

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D’Arcy Thompson

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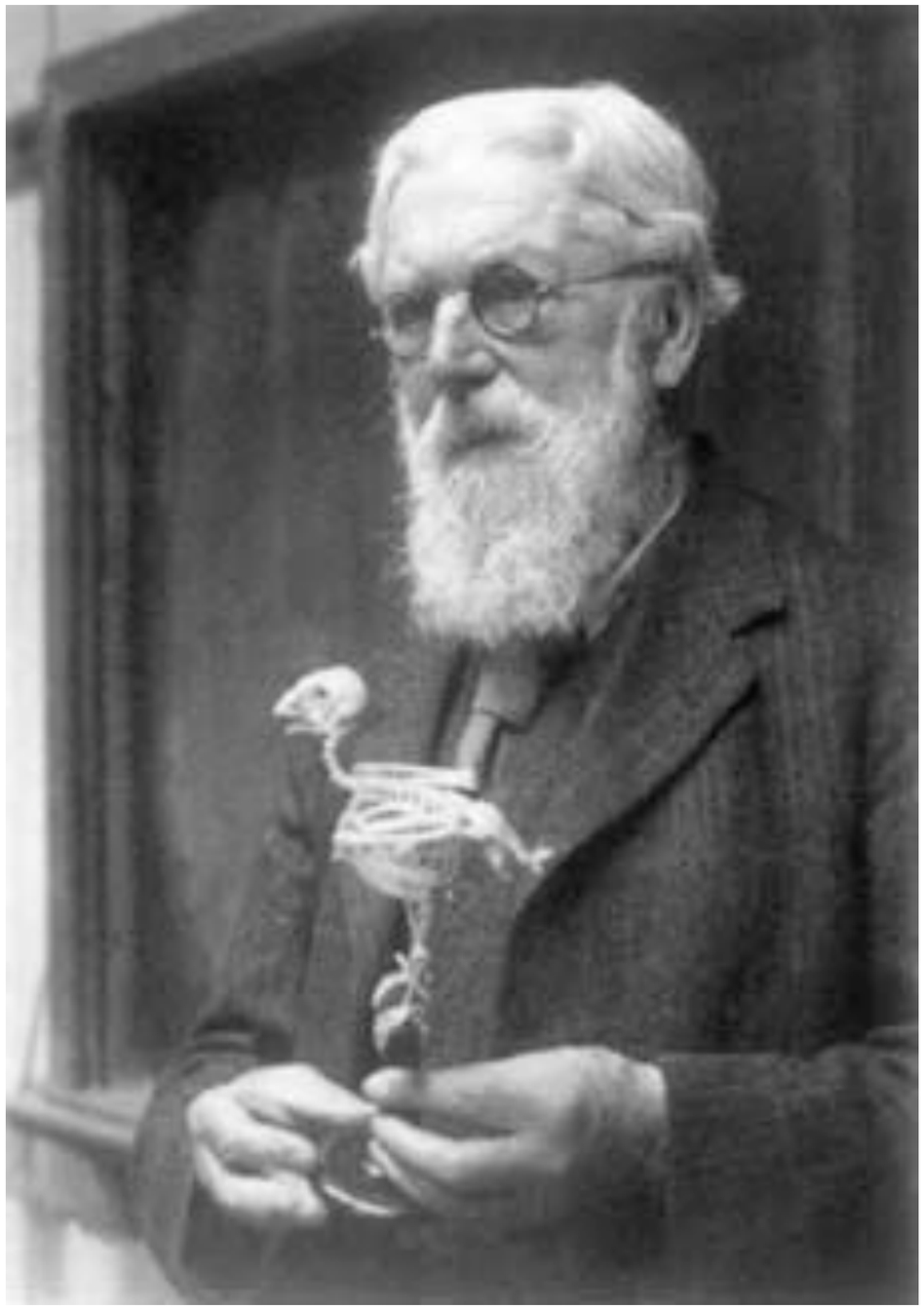

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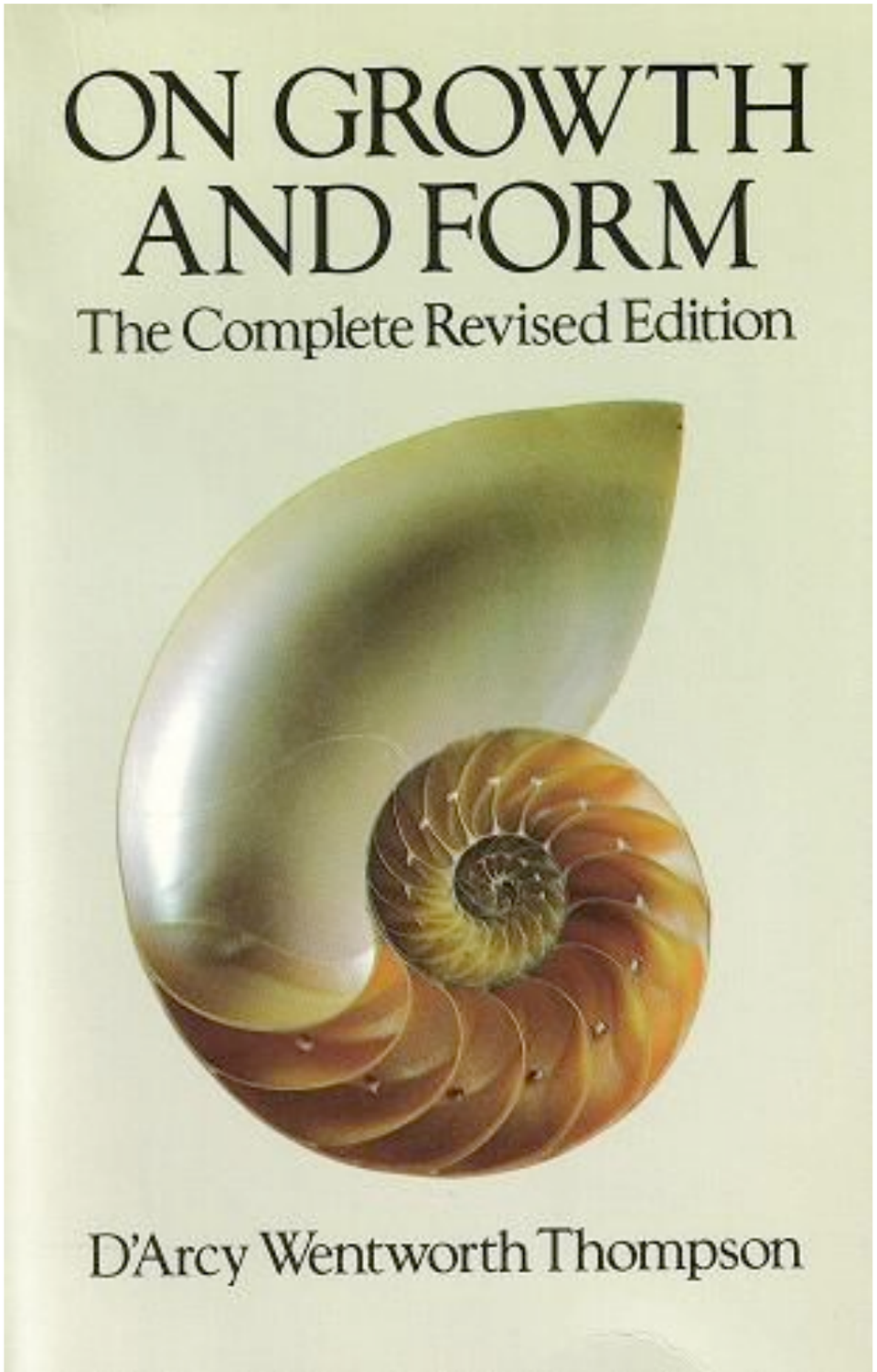

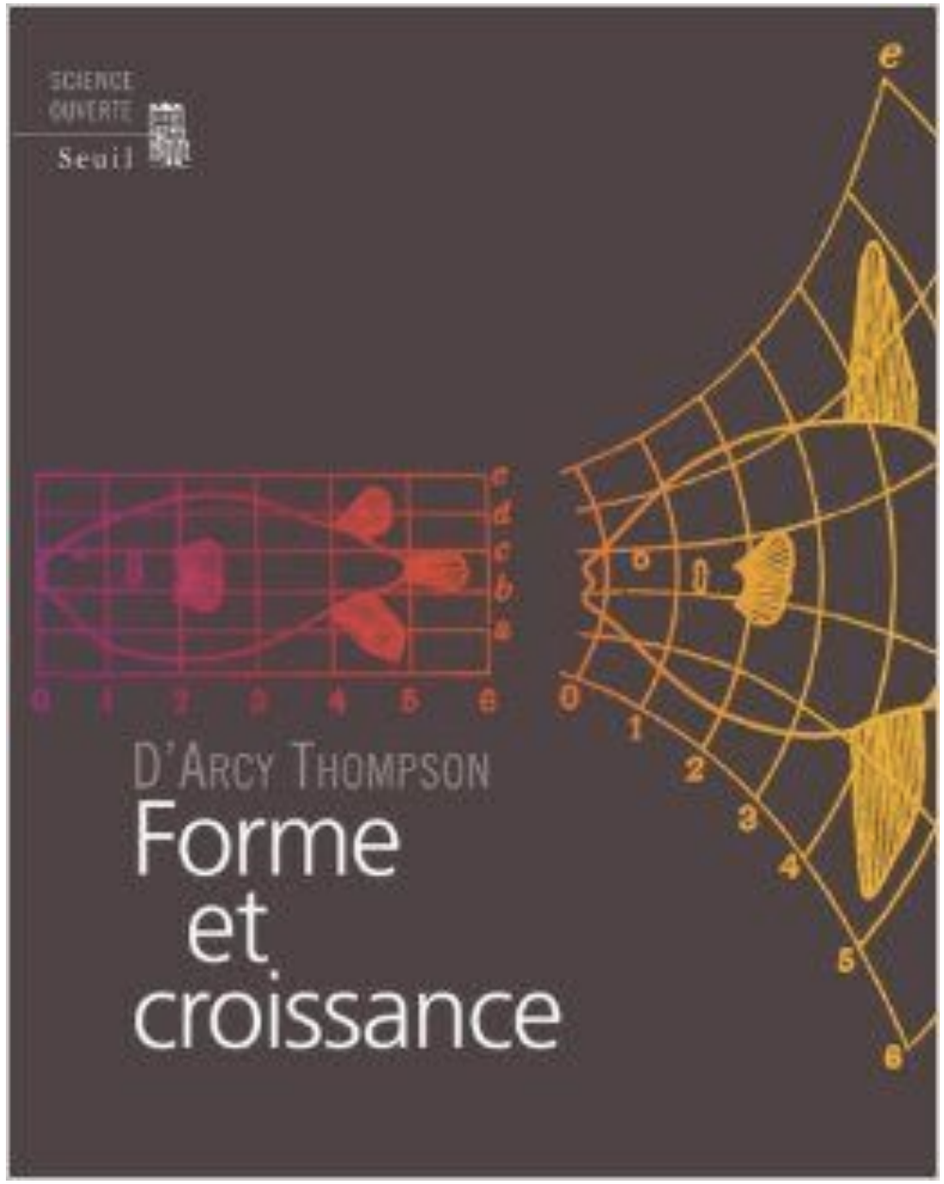

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René Thom

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Quand on sait où l'on va, on va rarement très loin.

http://www.maths.ed.ac.uk/~aar/papers/thom/data/citations.pdf

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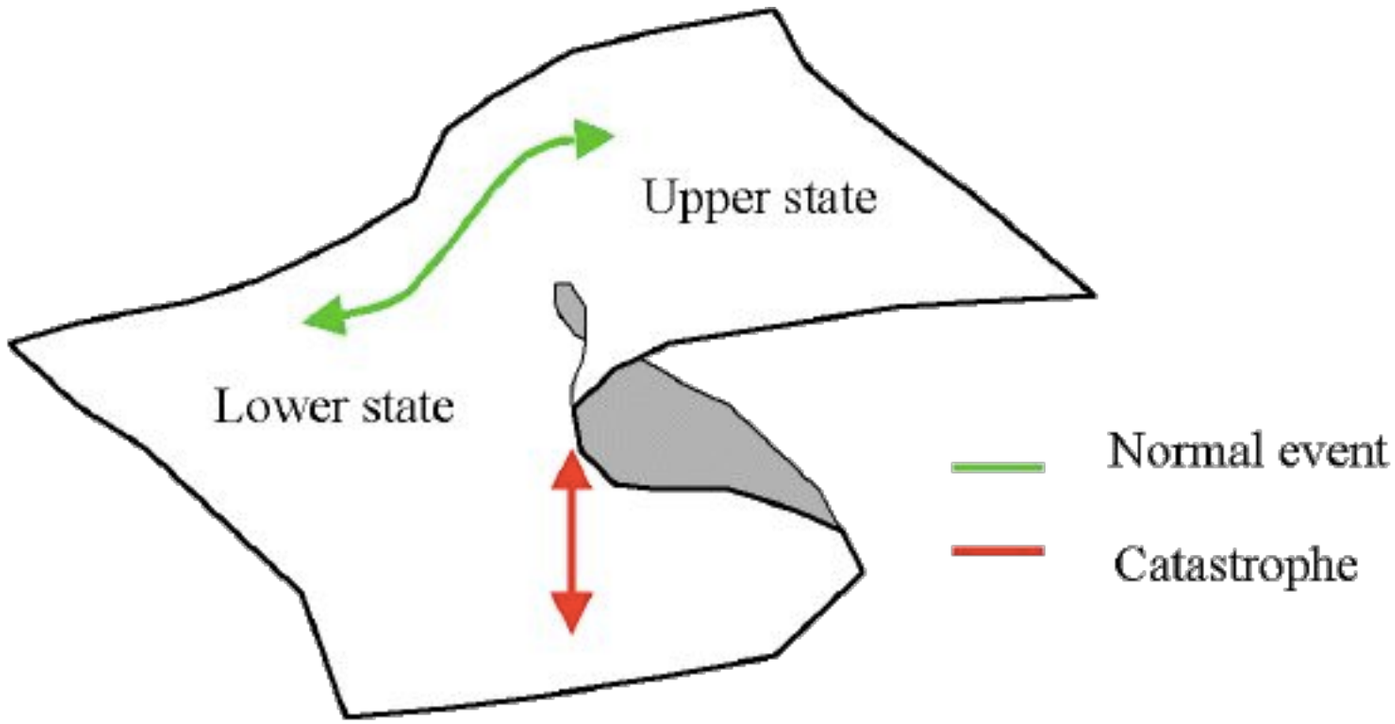

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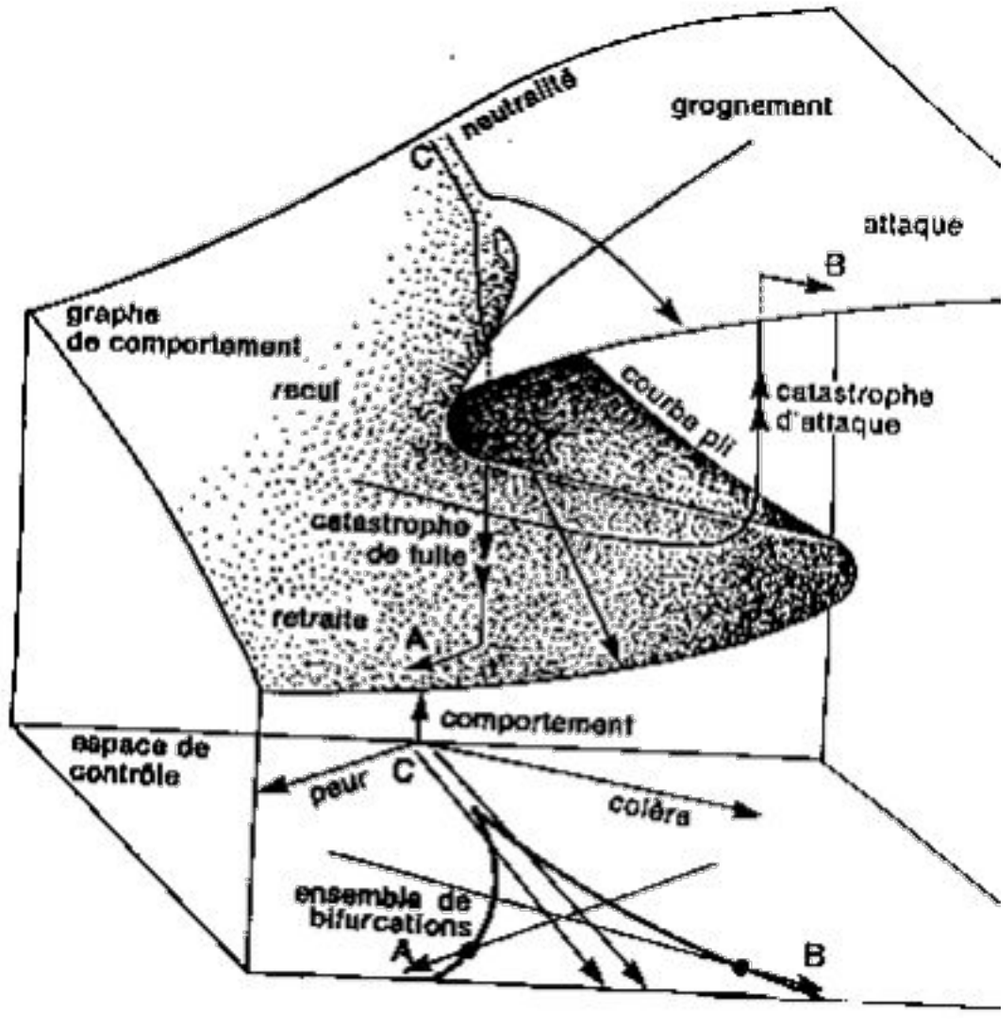

http://jeanzin.fr/ecorevo/philo/pretapen/thom.htm

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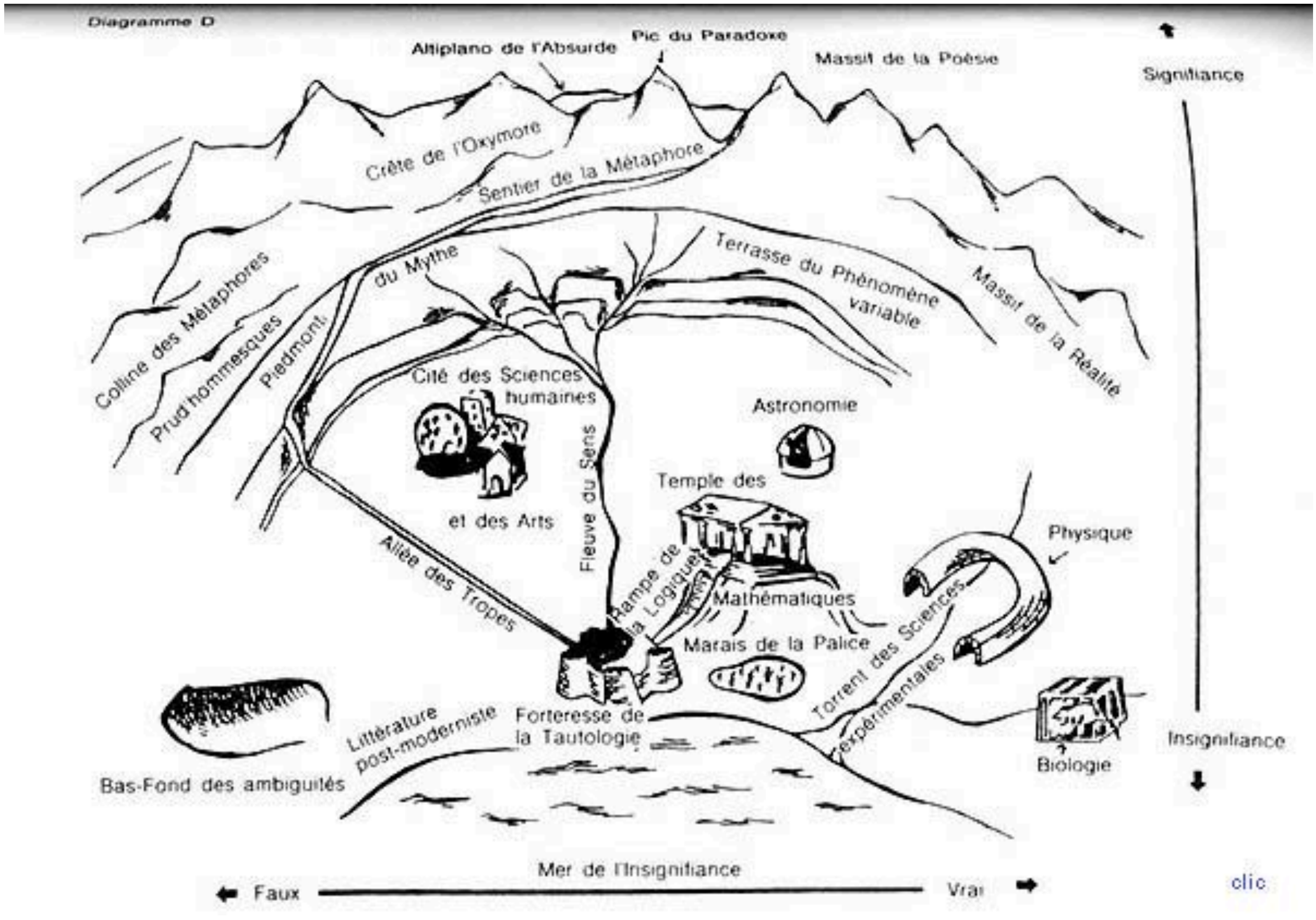
Thanks Emmanuel !



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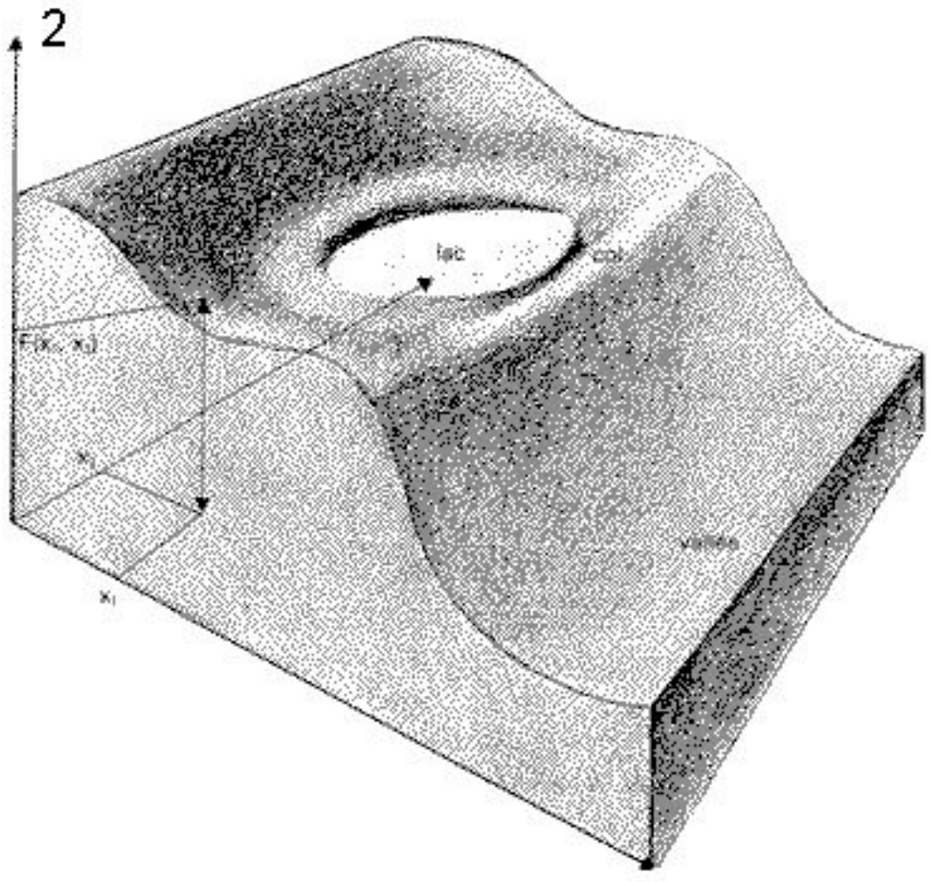

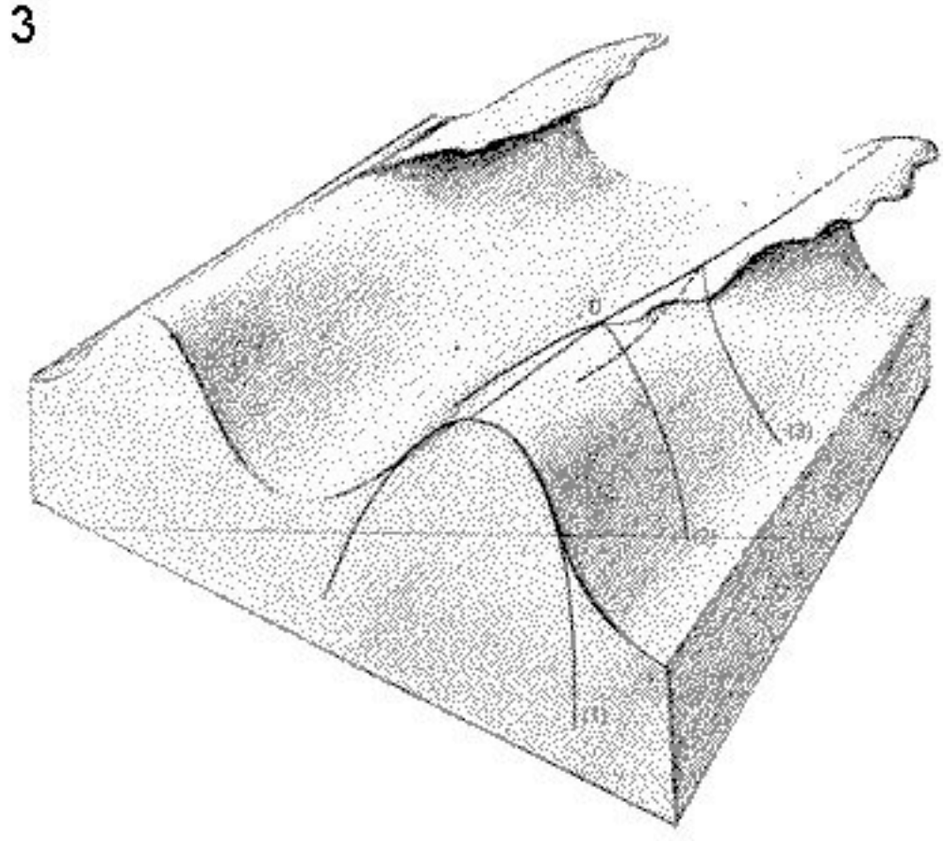

http://pst.chez-alice.fr/TCIvarEk.htm

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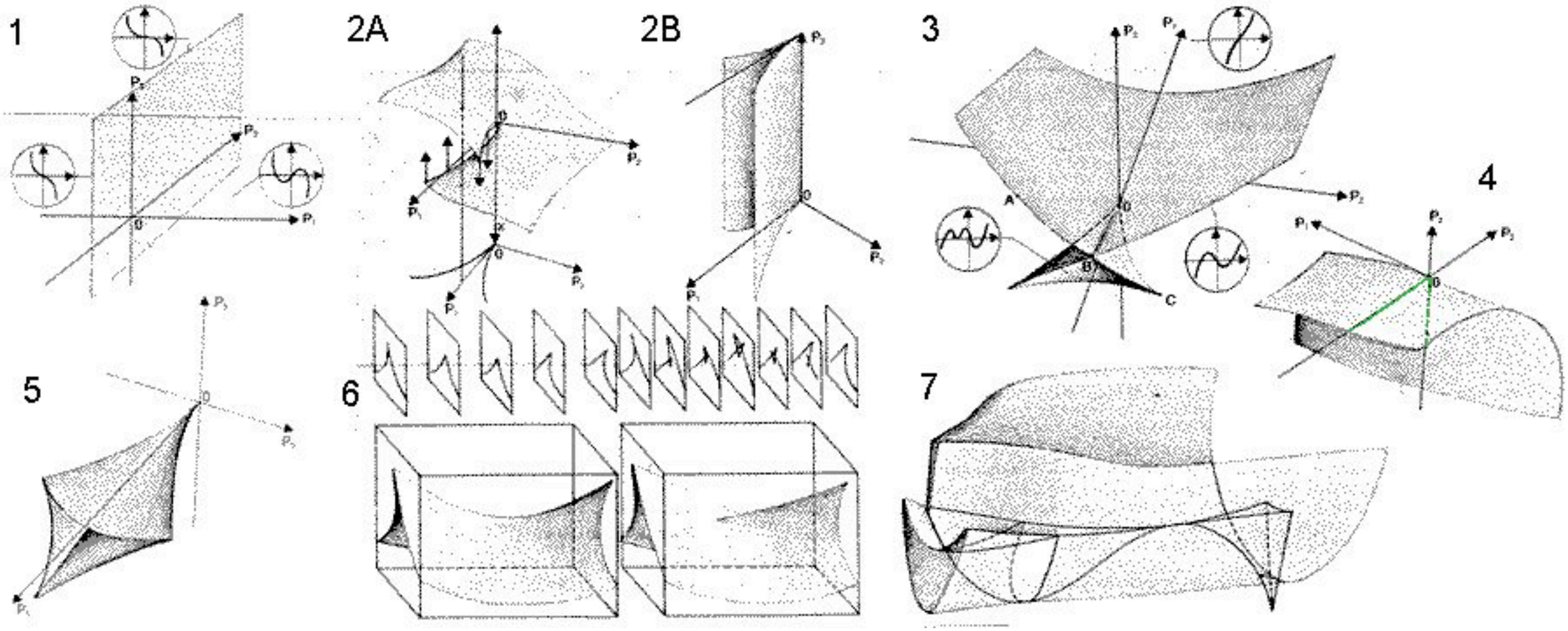

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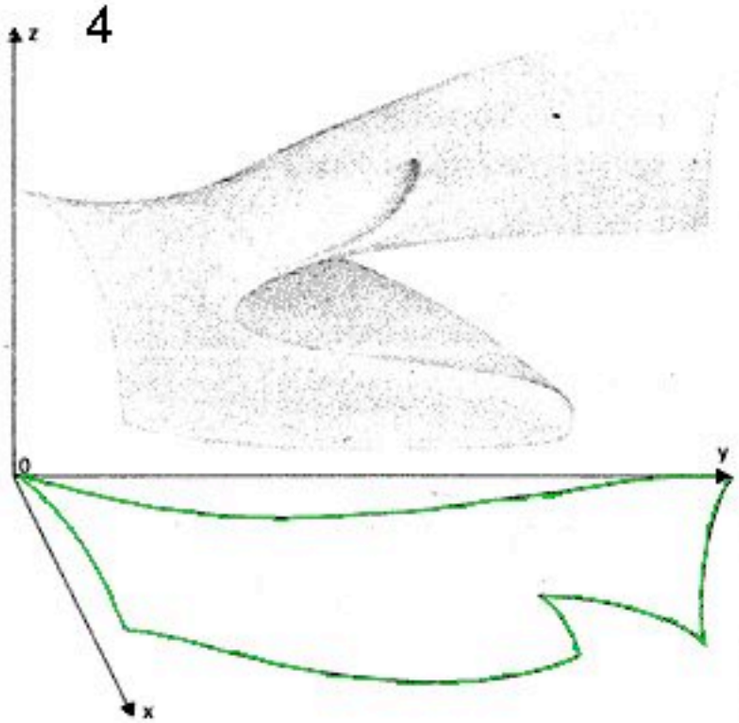

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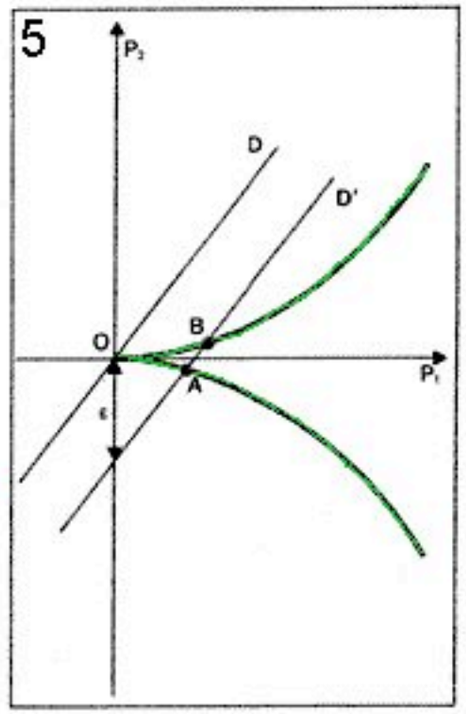

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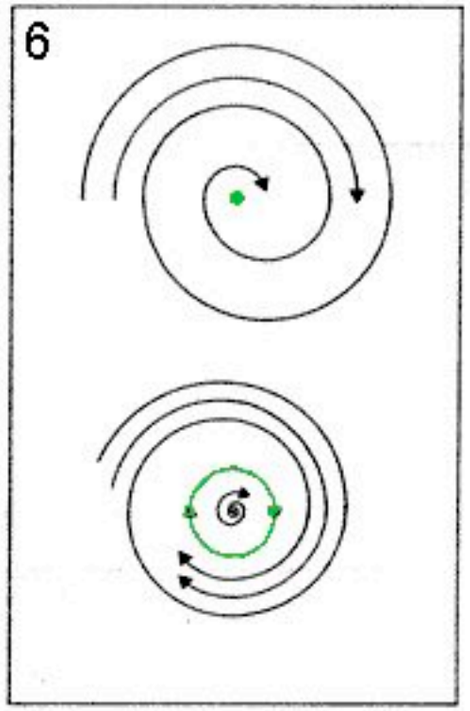

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RENÉ THOM
Centre de Mathématiques, I.H.E.S., Bures-sur-Yvette

STRUCTURAL STABILITY and MORPHOGENESIS

An Outline of a General Theory of Models

Translated from the French edition, as updated by the author, by

D. H. FOWLER
University of Warwick
With a Foreword by
C. H. WADDINGTON

1975

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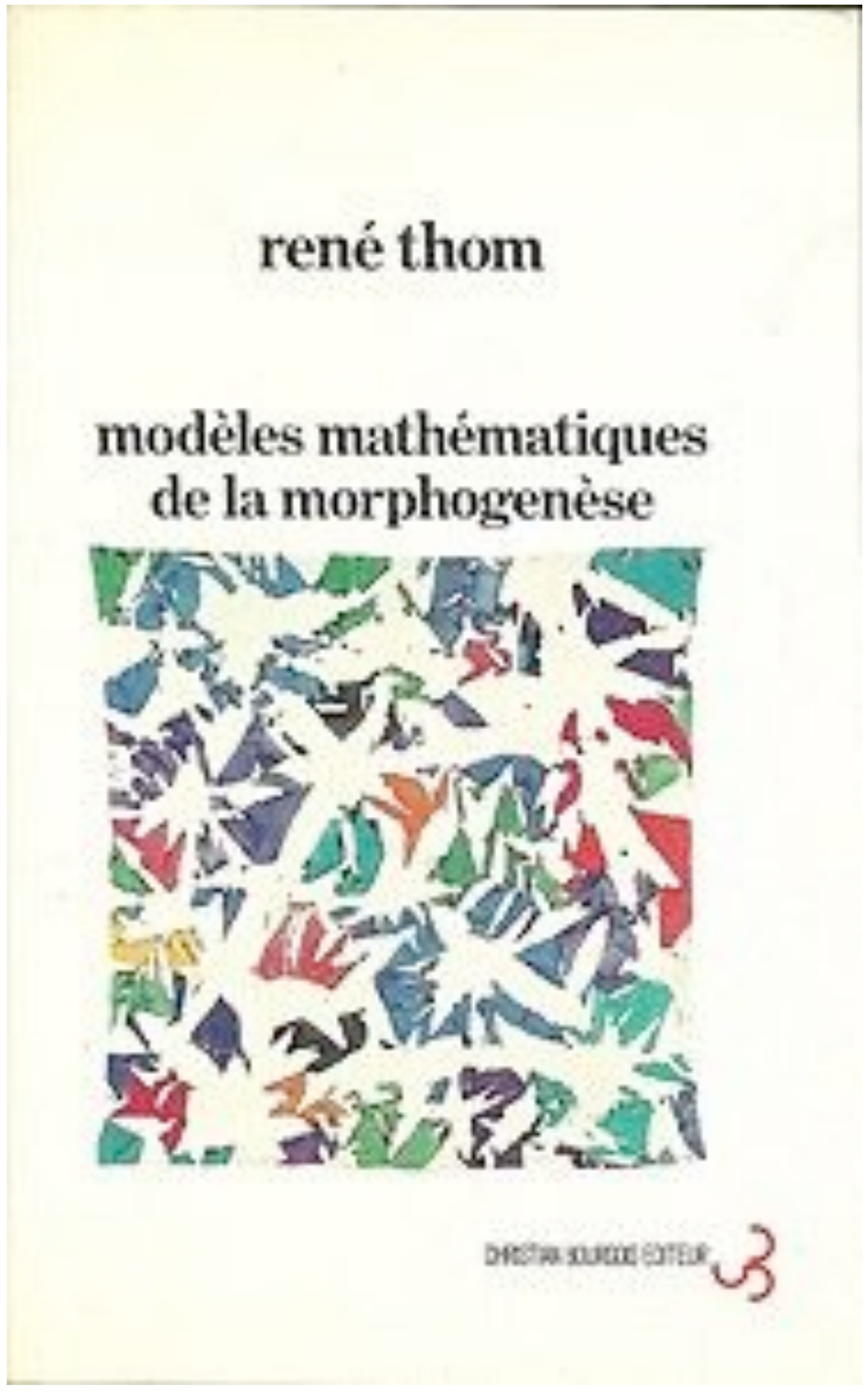

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Benoît Mandelbrot

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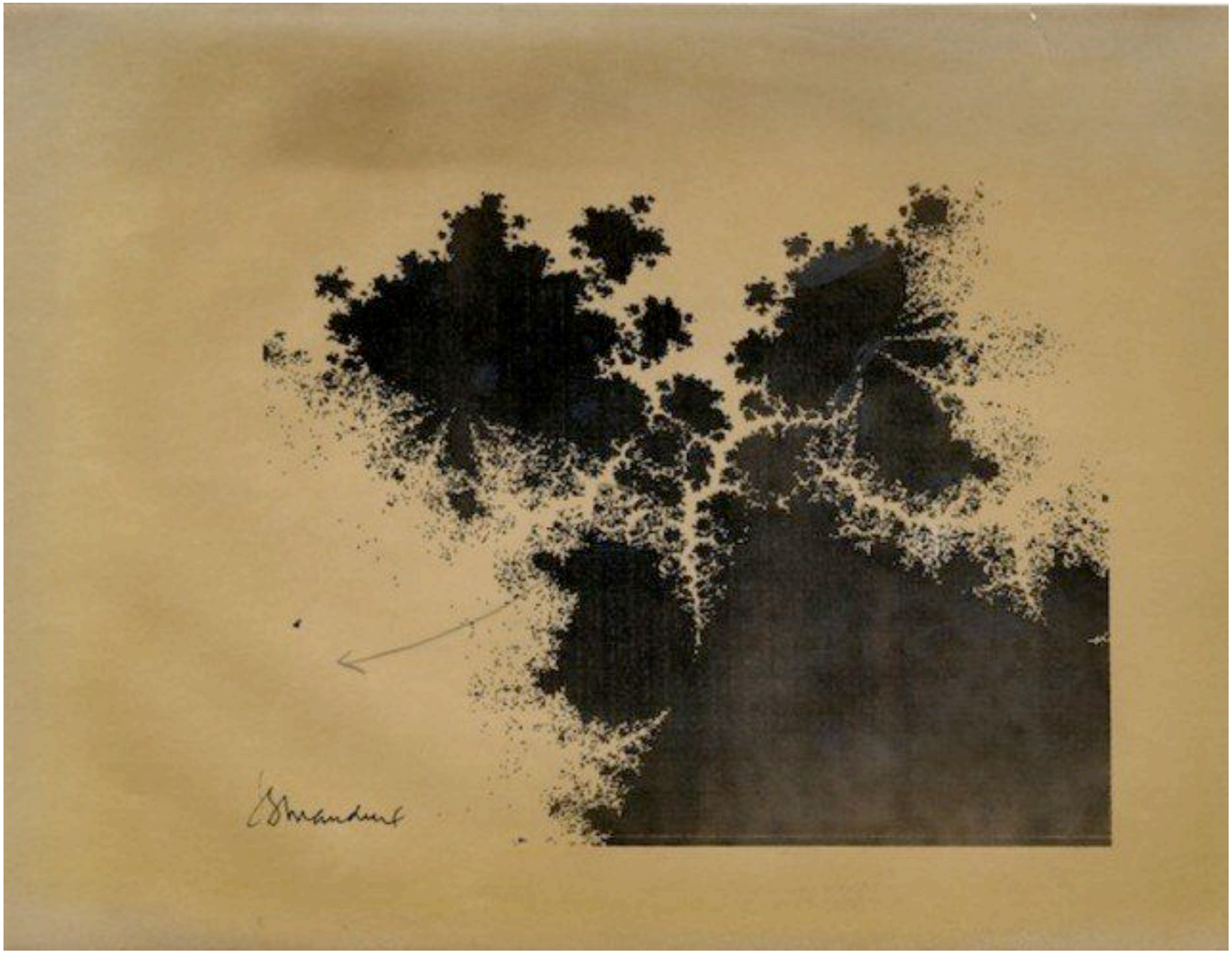

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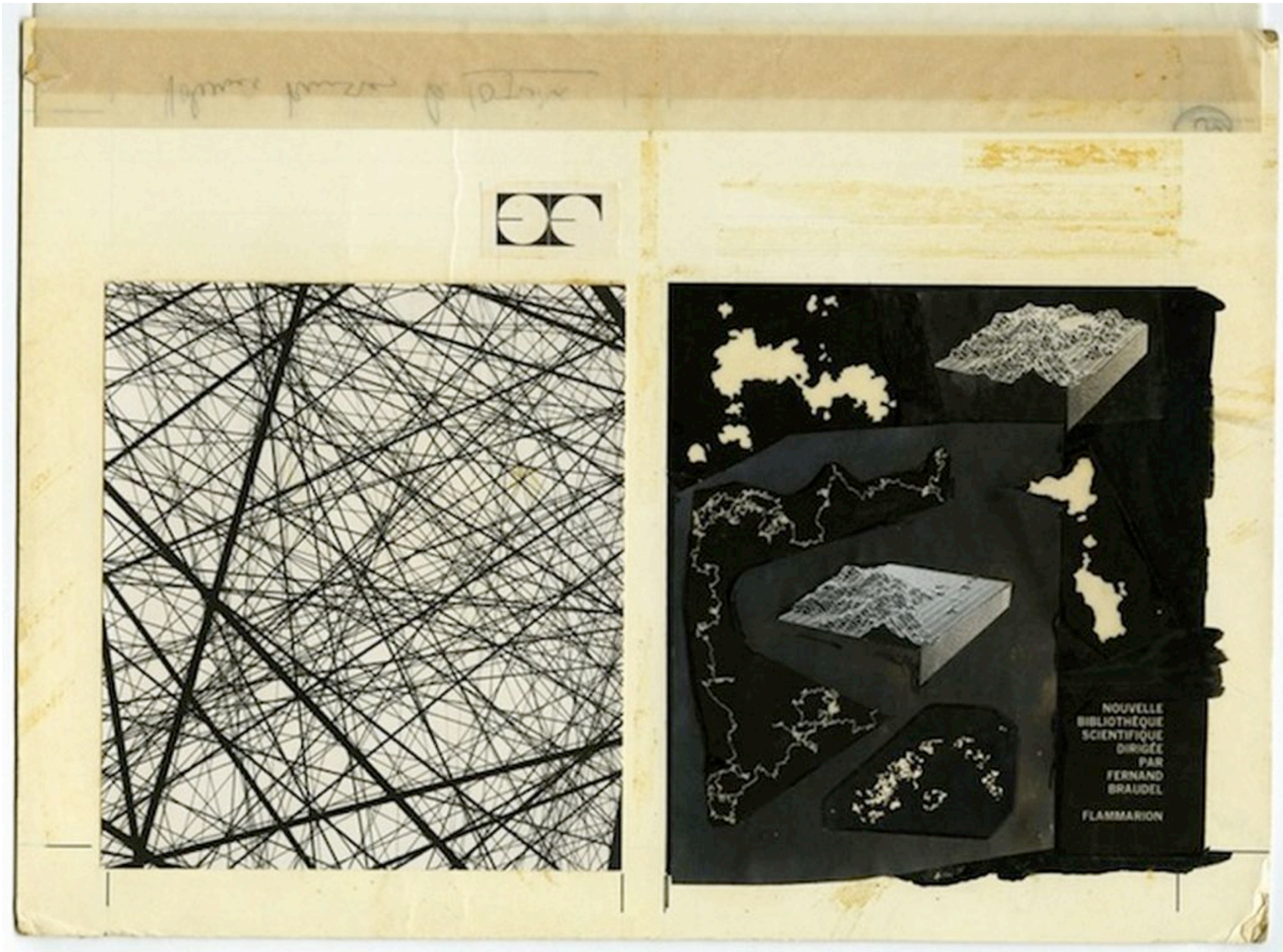

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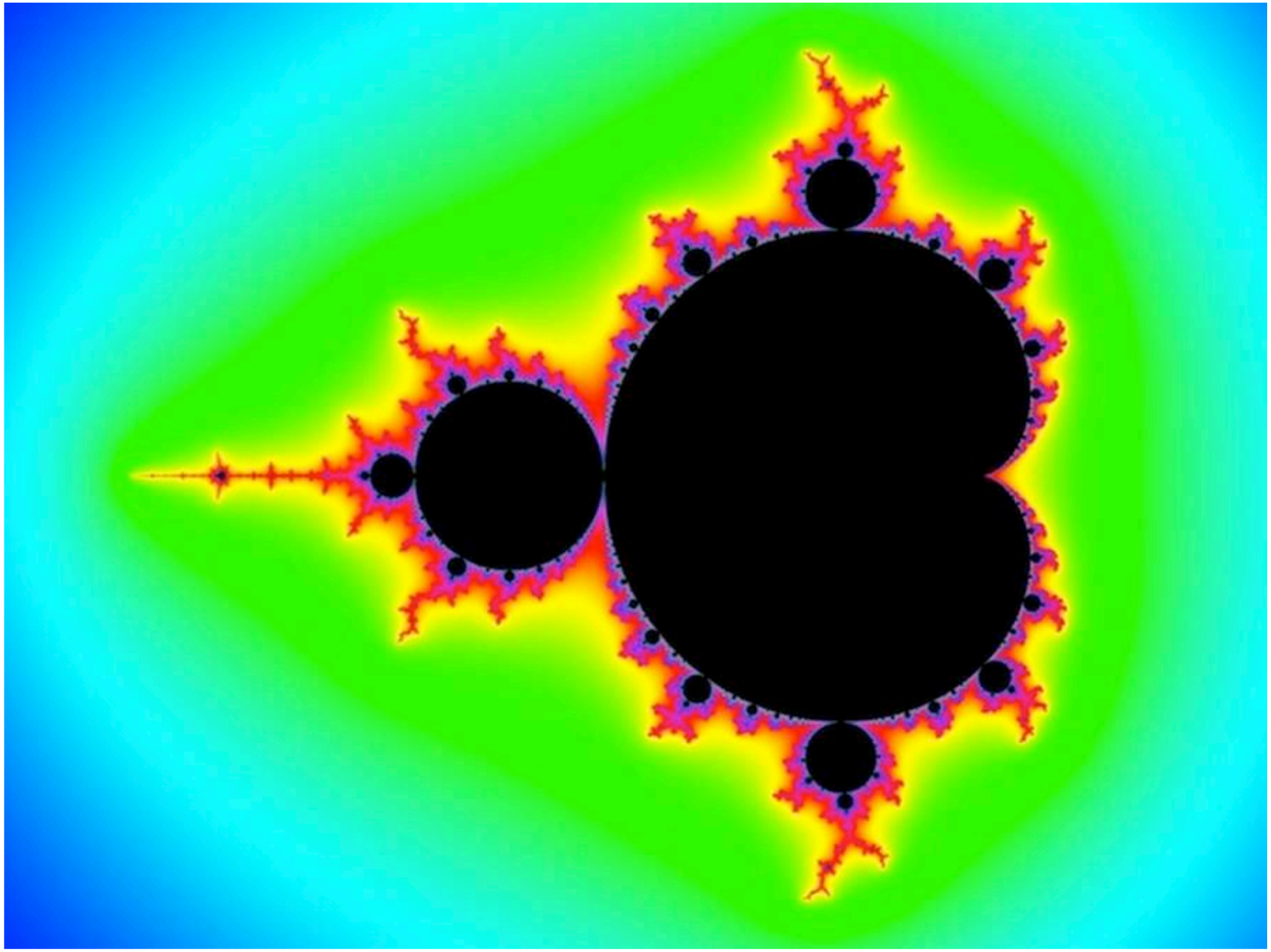

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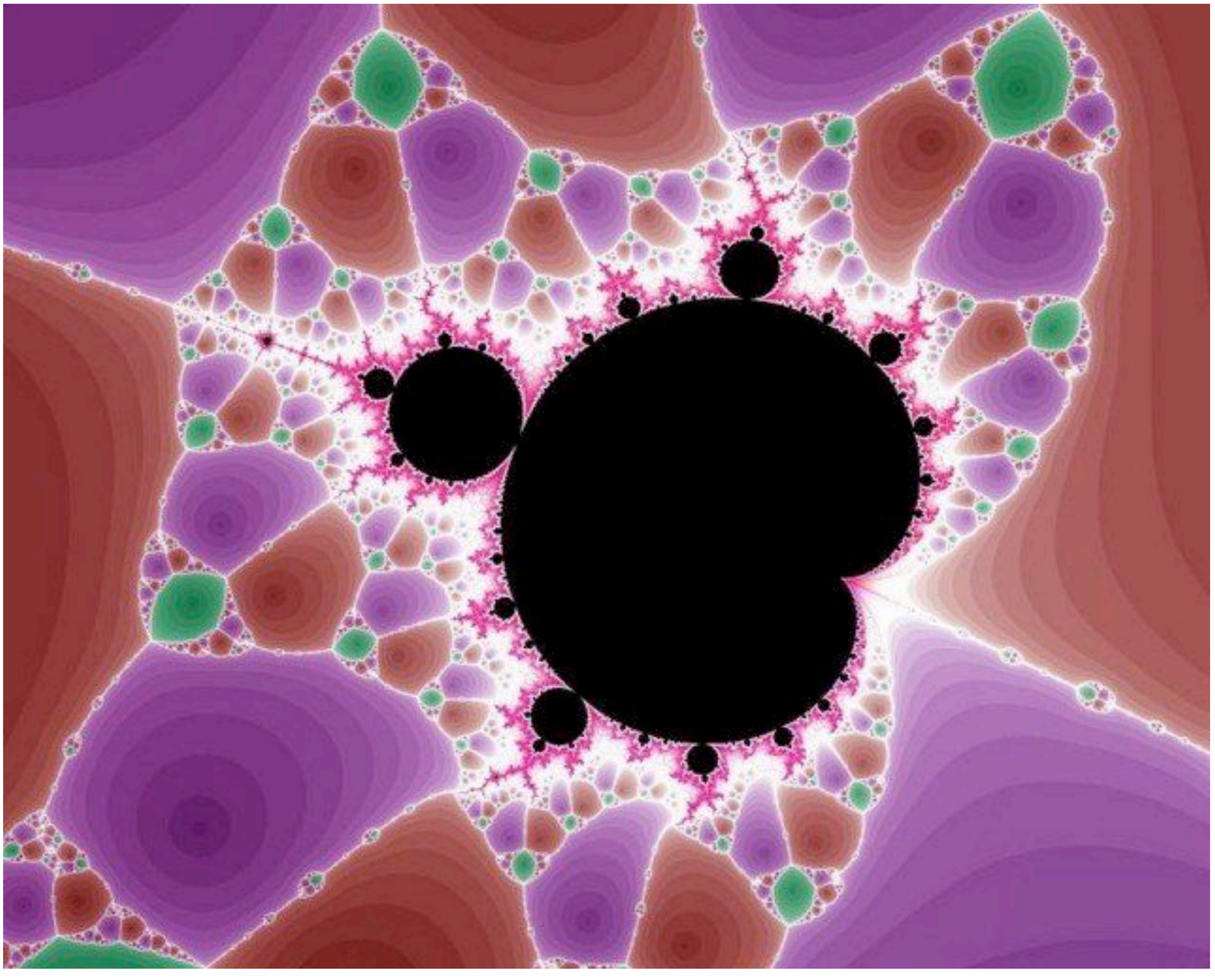

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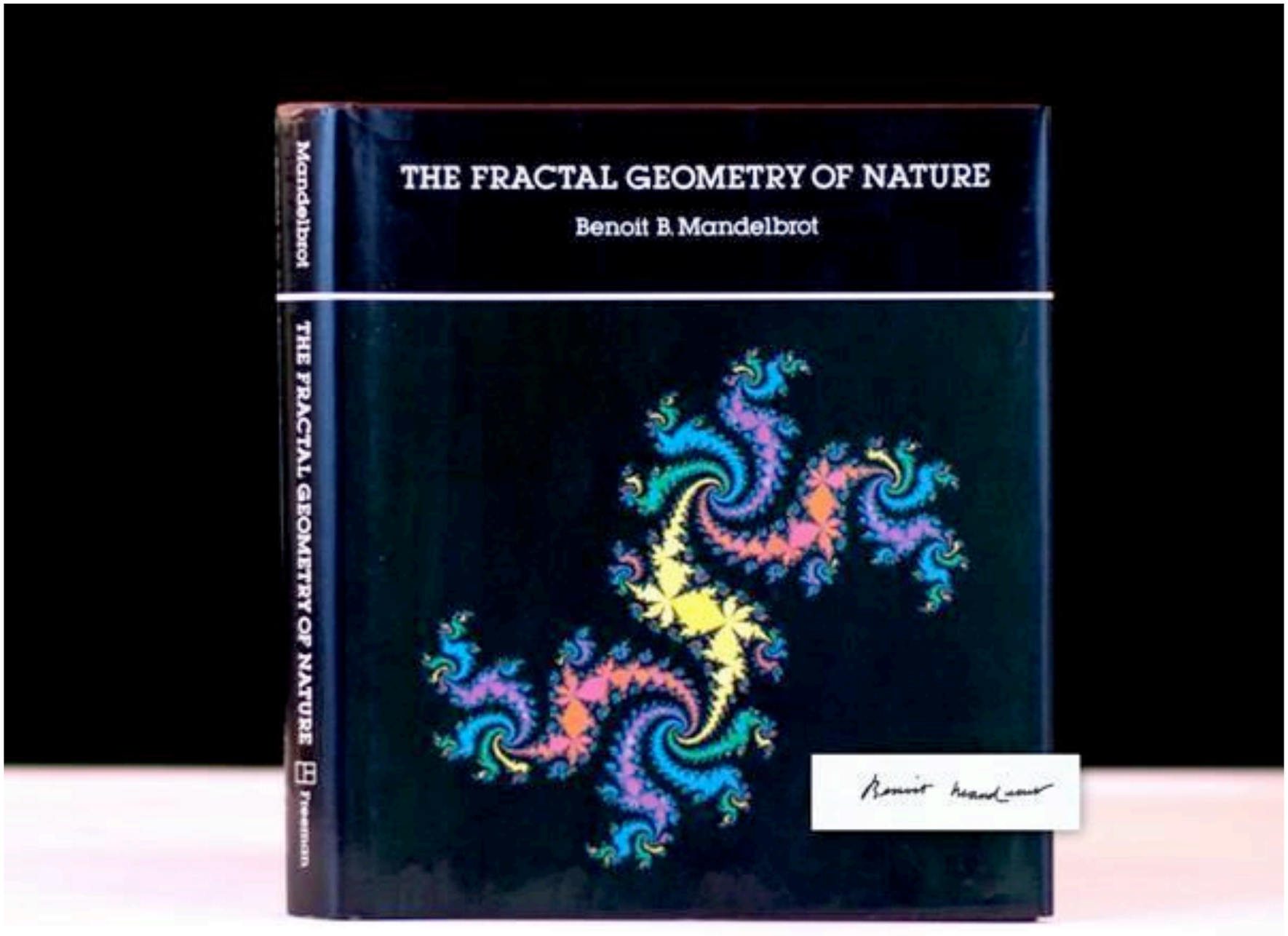

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Unit = 200 km,
Length = 2400 km (approx.)

Unit = 100 km,
Length = 2800 km (approx.)

Unit = 50 km,
Length = 3400 km (approx.)

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Scale Theory

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Laurent Nottale

Vincent Bontemps
(atelier simondon)

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http://www.chss.uqam.ca/Portals/0/docs/articles/gingras_bontems_SSI.pdf

Studies of science

Etudes sur la science

SSI

Vincent Bontems et Yves Gingras

De la science normale à la science marginale. Analyse d'une bifurcation de trajectoire scientifique: le cas de la Théorie de la Relativité d'Echelle

Résumé. *Dans le champ scientifique, les agents peuvent choisir de collaborer à la science 'normale', se placer à l'avant-garde la plus légitime (les 'supercordes', la 'matière noire', etc.), ou encore développer leurs recherches dans un nouveau cadre théorique, avec tous les risques que cela comporte. La marginalité d'une théorie soulève la question de la stratégie de ceux qui y collaborent même au détriment de leur 'intérêt' à court terme, qui oriente plutôt vers la compétition immédiate pour occuper les positions centrales dans les domaines déjà constitués. La théorie de la relativité d'échelle (TRE) présente l'intérêt d'une telle situation car elle ouvre une possibilité qu'il faut créer de toutes pièces. S'y investir engage davantage que le choix d'un projet 'risqué' (par sa difficulté même) dans le cadre d'un paradigme existant car, d'une part, la TRE innove par rapport aux bases conceptuelles déjà acceptées par tous et, d'autre part, se trouve aussi marginalisée par rapport à l'avant-garde la plus légitime (comme celle des 'supercordes'). Ainsi, le cas de la TRE permet d'étudier une région du champ scientifique peu explorée par une sociologie des sciences qui fixe surtout son regard sur les cas extrêmes: histoire de théories devenues reconnues ou controverses spectaculaires.La TRE occupe encore, en 2006, une position marginale dans le champ de la physique. Son statut diffère toutefois radicalement des 'théories' produites à l'extérieur du champ, sans correspondre pour autant à celui de la science stabilisée et sanctionnée: comme nous allons le montrer par une analyse bibliométrique détaillée, sa diffusion au sein du champ scientifique est relativement modeste mais réelle, et ses résultats, quand ils reçoivent la sanction d'une publication scientifique, sont rarement pris en compte par les chercheurs qui n'y collaborent pas déjà. Cette*

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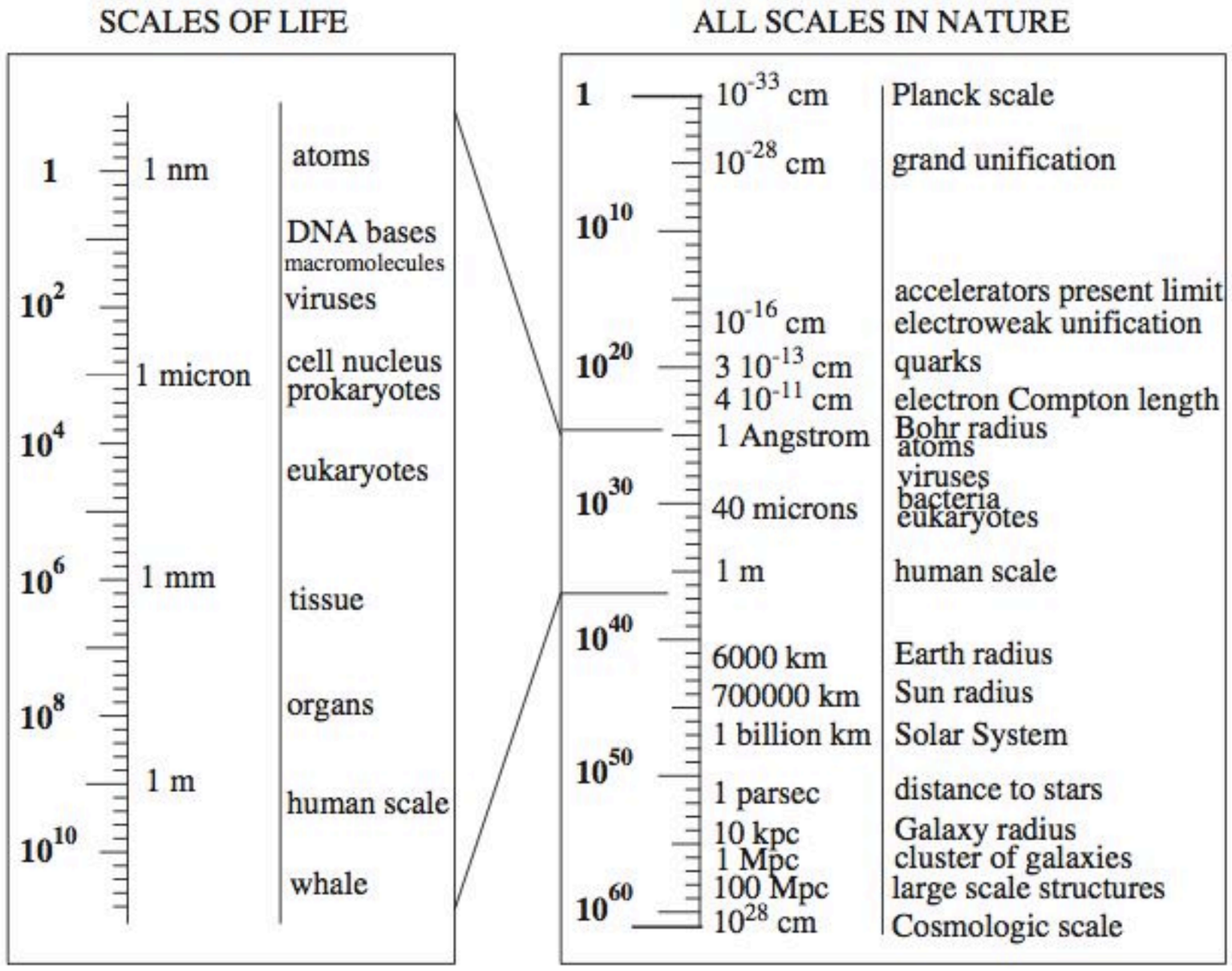

Fig. 2. Scales in nature. The range of biological scales (left), embedded in the range of physical scales (right).

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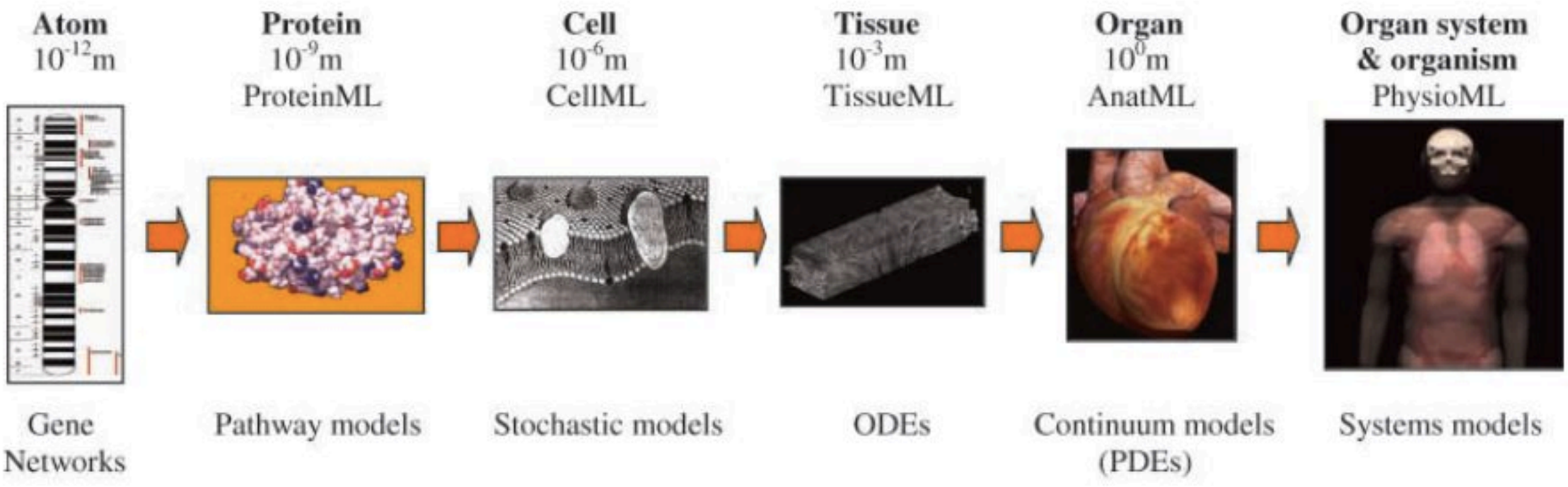
The Grand Challenge of Integrative Systems Biology: Multiscale Integration



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Multiple formalisms used to model biological systems
at their different levels of organization

Molecular: e.g. ordinary and partial differential equations

Cellular: e.g. logical networks, cellular automata

Organ: e.g. finite element lattices

Often based on incompatible principles

Extended mathematical framework needed to enable
multiscale integration across all levels simultaneously

http://www.ens-lyon.fr/Joliot-Curie/IMG/pdf/AUFFRAY-NOTTALE-ENSL-020311-2.pdf

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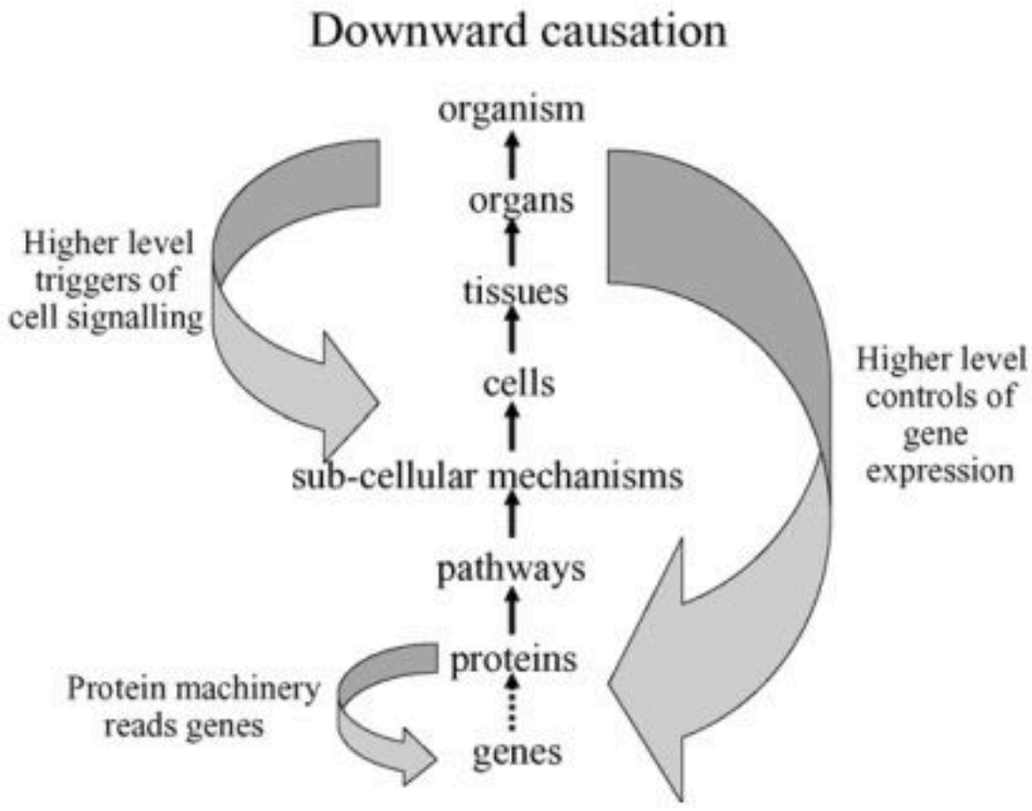
Formalise the principle of biological relativity



There is no priviledged level of causality

http://www.ens-lyon.fr/Joliot-Curie/IMG/pdf/AUFFRAY-NOTTALE-ENSL-020311-2.pdf

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According to the principle of relativity, natural laws are valid in any system of coordinates, whatever its state.

The state of any system can be defined only relatively to another system.

Only scale ratios have a physical meaning, there is no absolute scale.

Resolution is an inherent (relative) property of space-time geometry.

According to the principle of scale relativity, the fundamental laws of nature apply whatever the state of scale of the coordinate system.

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Space-time is continuous and generally non-differentiable,
therefore fractal (explicitly scale-dependent and divergent).

Therefore, there is an infinity of paths, identified with the geodesics
(shortest in proper time), which are themselves fractal.

In this framework, the fundamental equations of dynamics can be
integrated in the form of a generalized Schrödinger equation.

It becomes possible to derive linear and non-linear scale laws to
describe the self-organization of biological structures and
quantum-type behaviours.

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Predictions of scale relativity in astrophysics

More than 50 validated through subsequent observations

Derivation of the axioms of quantum mechanics

General relativity and quantum mechanics in common (geometric) framework

Models for self-organization of biological systems

Tree of life described by log-periodic scale laws

Morphogenesis and growth described by a macroscopic Schrödinger-type equation

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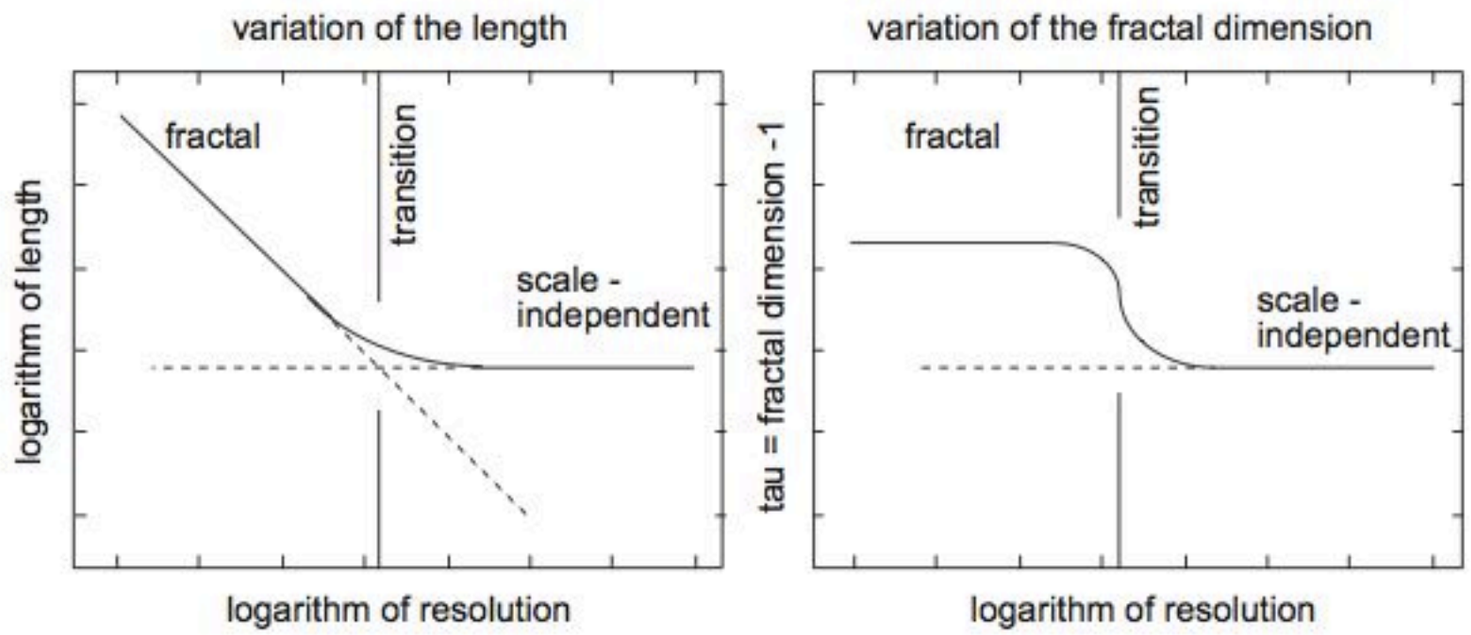

Fig. 3. Scale dependence of the length and of the effective fractal dimension D_F (or, equivalently, of the effective scale exponent or "scale time" $\tau = D_F - 1$), in the case of "inertial" scale laws (which are solutions of the simplest, first order scale differential equation): toward the small scale one gets a scale-invariant law with constant fractal dimension, while the explicit scale dependence is lost at scales larger than some transition scale, beyond which one recovers $D_F = D_T = 1$ (see text).

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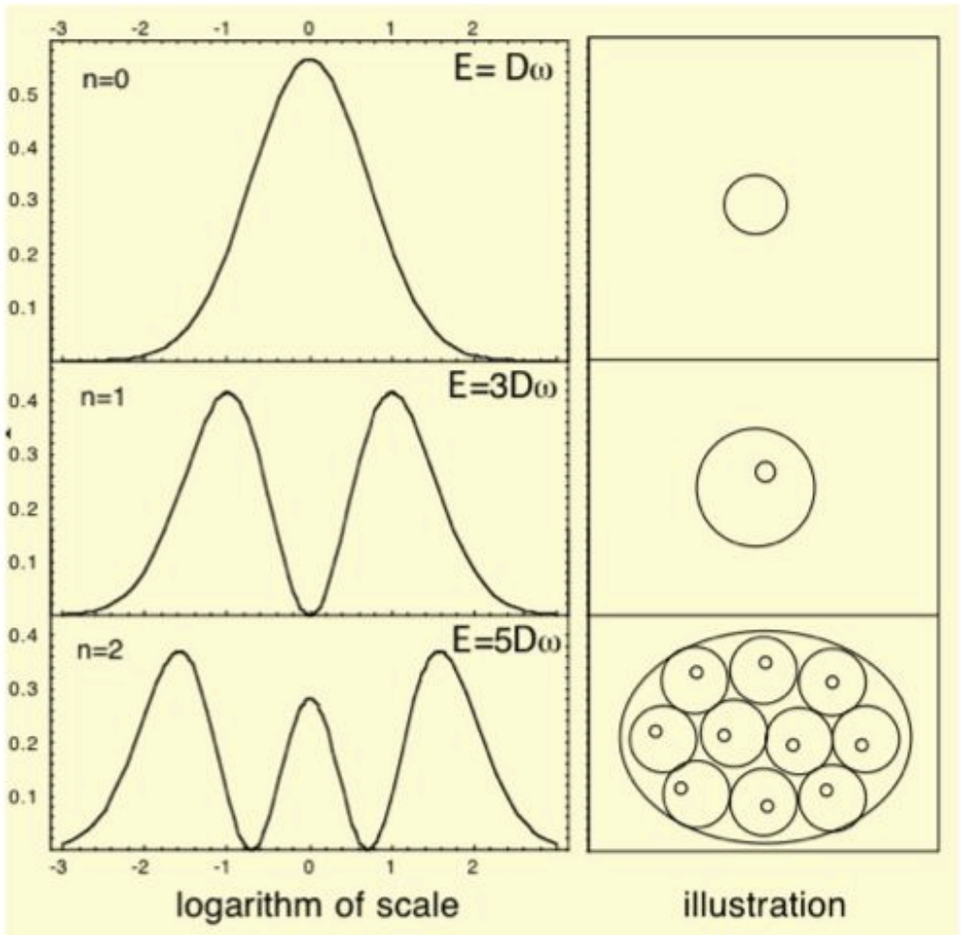
Figure 8. Schematic illustration of a model of hierarchical organization based on a Schrödinger equation acting in scale space. The fundamental mode corresponds to only one level of hierarchy, while the first and second excited modes describe respectively two, then three embedded hierarchical structures.



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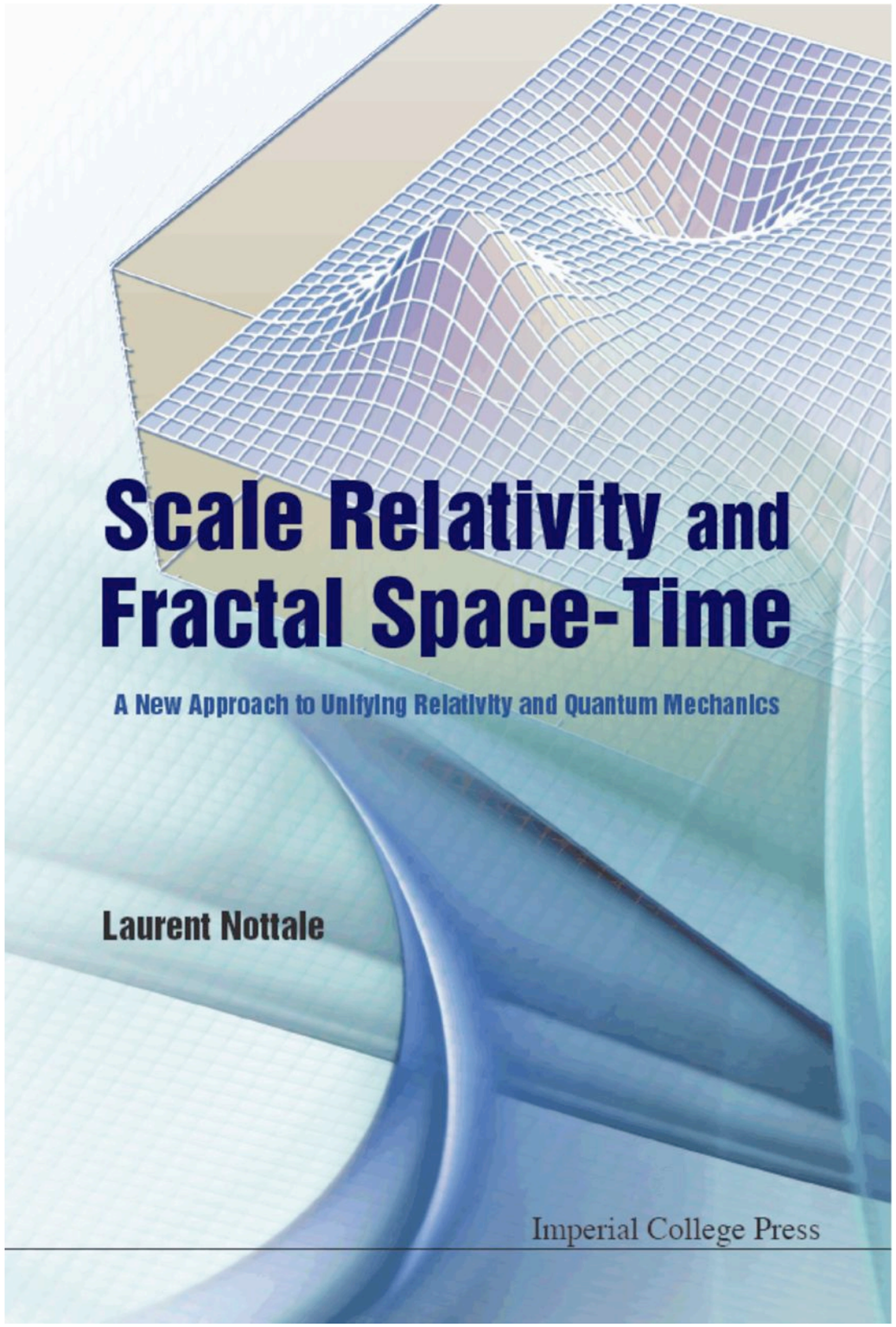

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Fractal Folding across Scales

MetaStability

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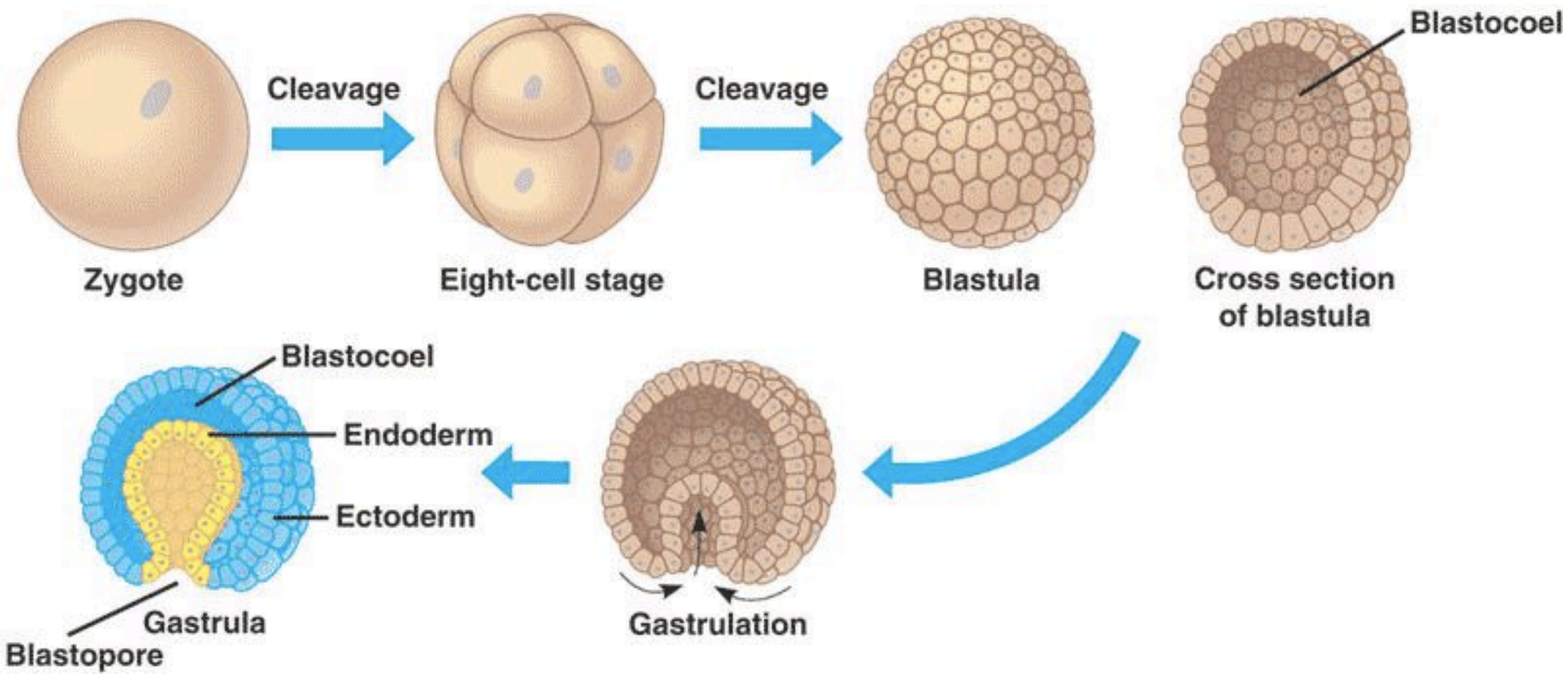

Gastrulation

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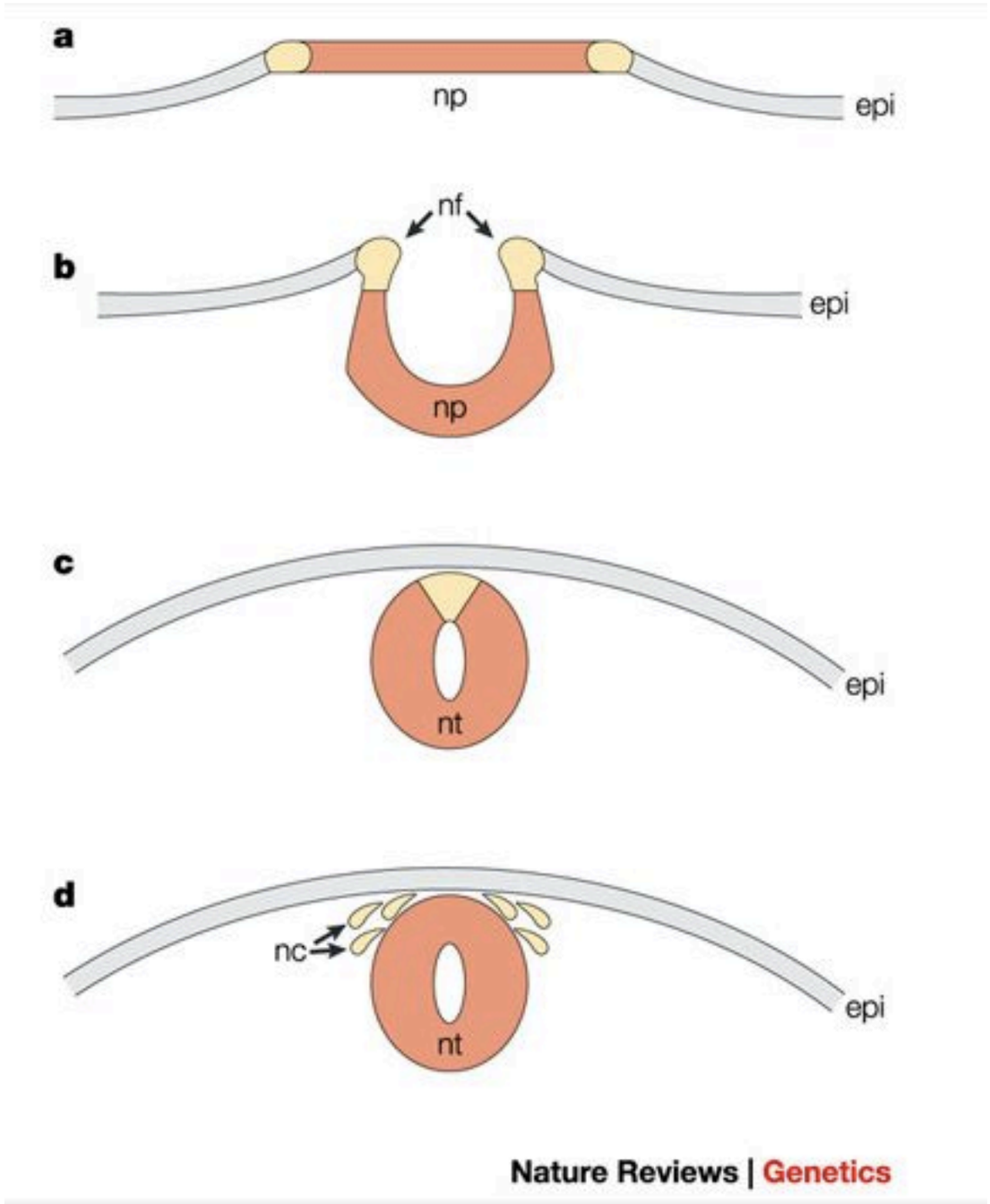

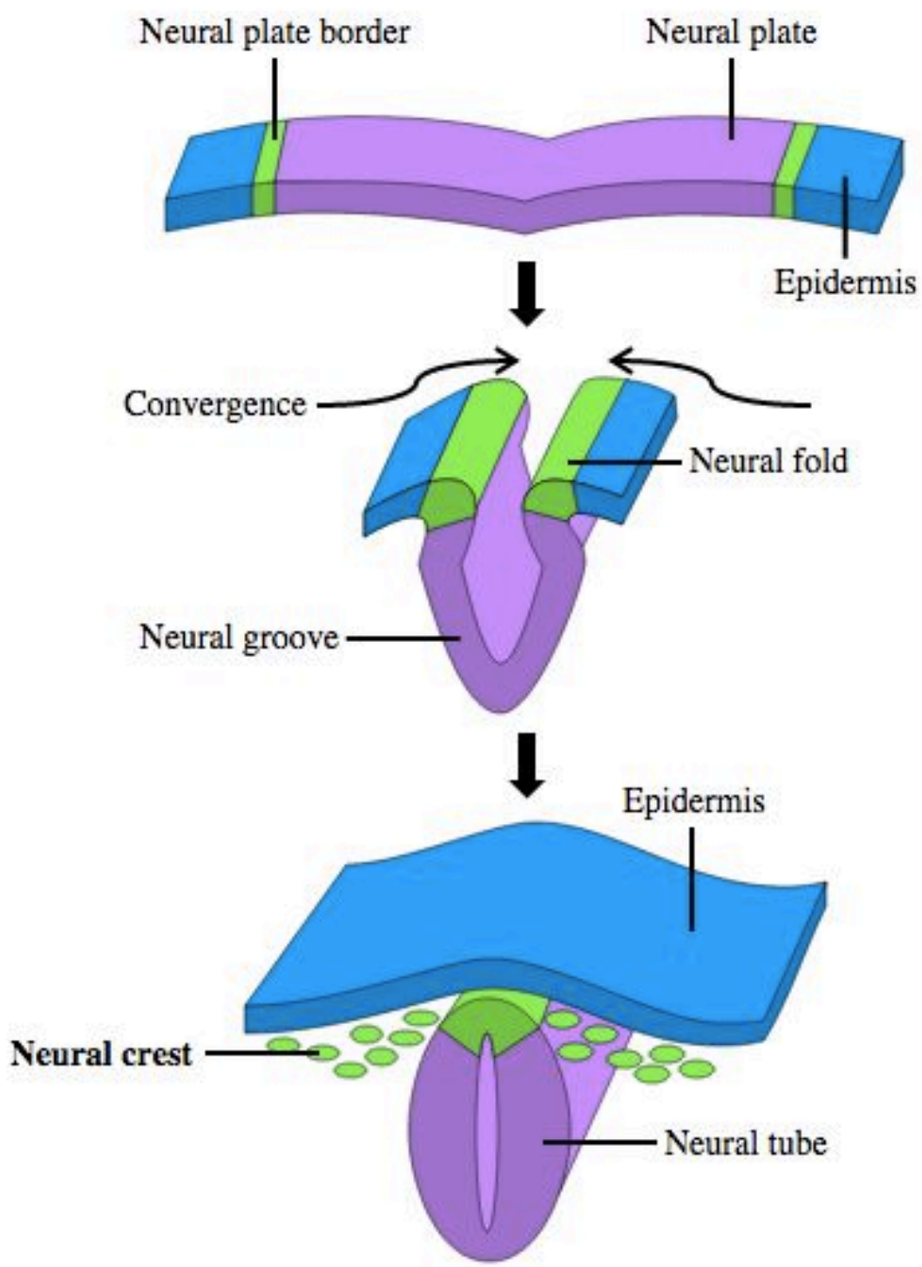

Neurulation

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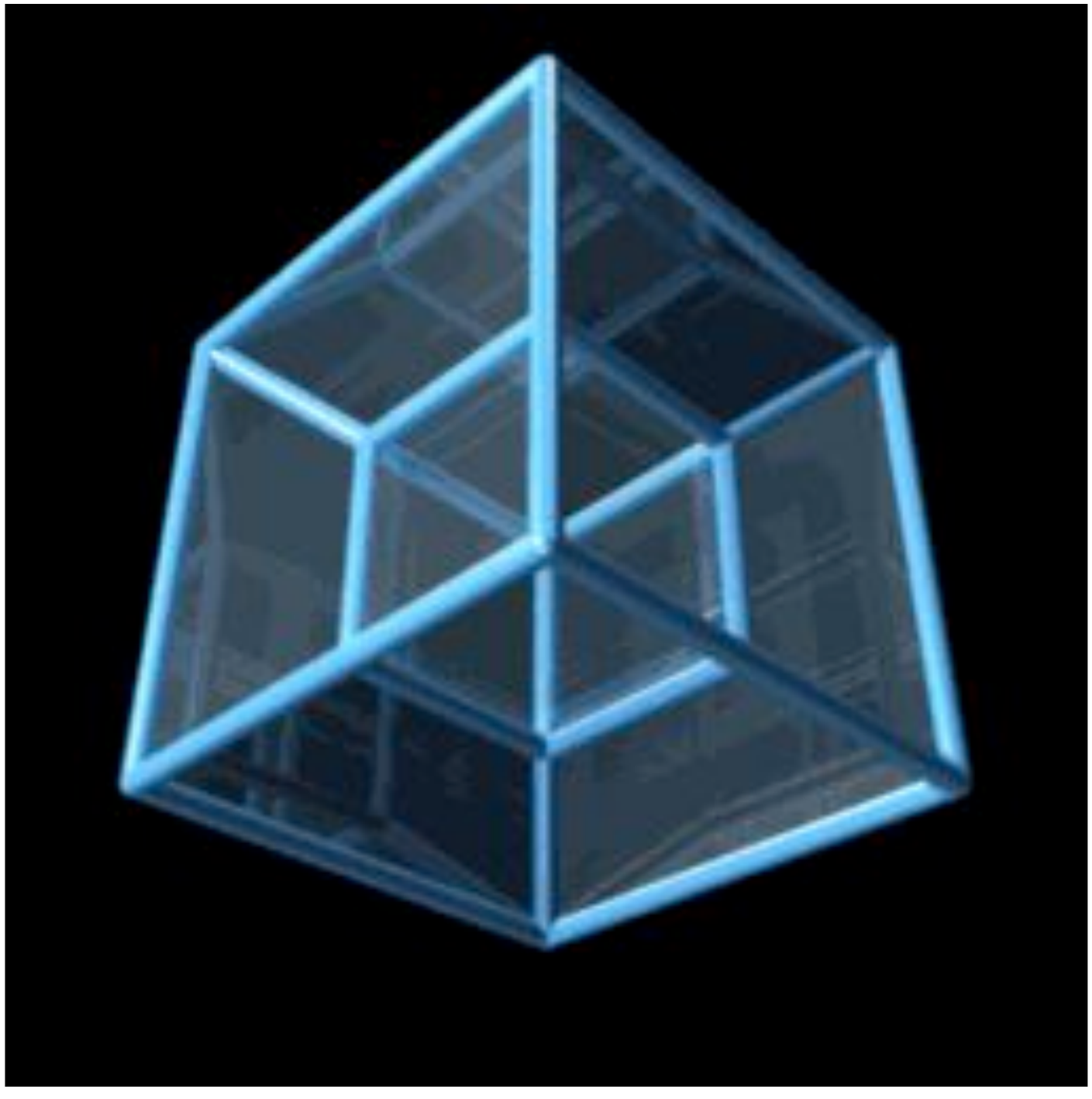

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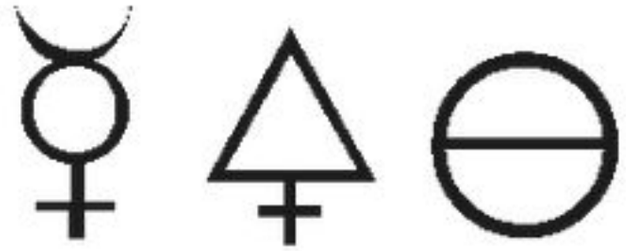
Archemy



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Symbolic
Iconic theory
Enactive

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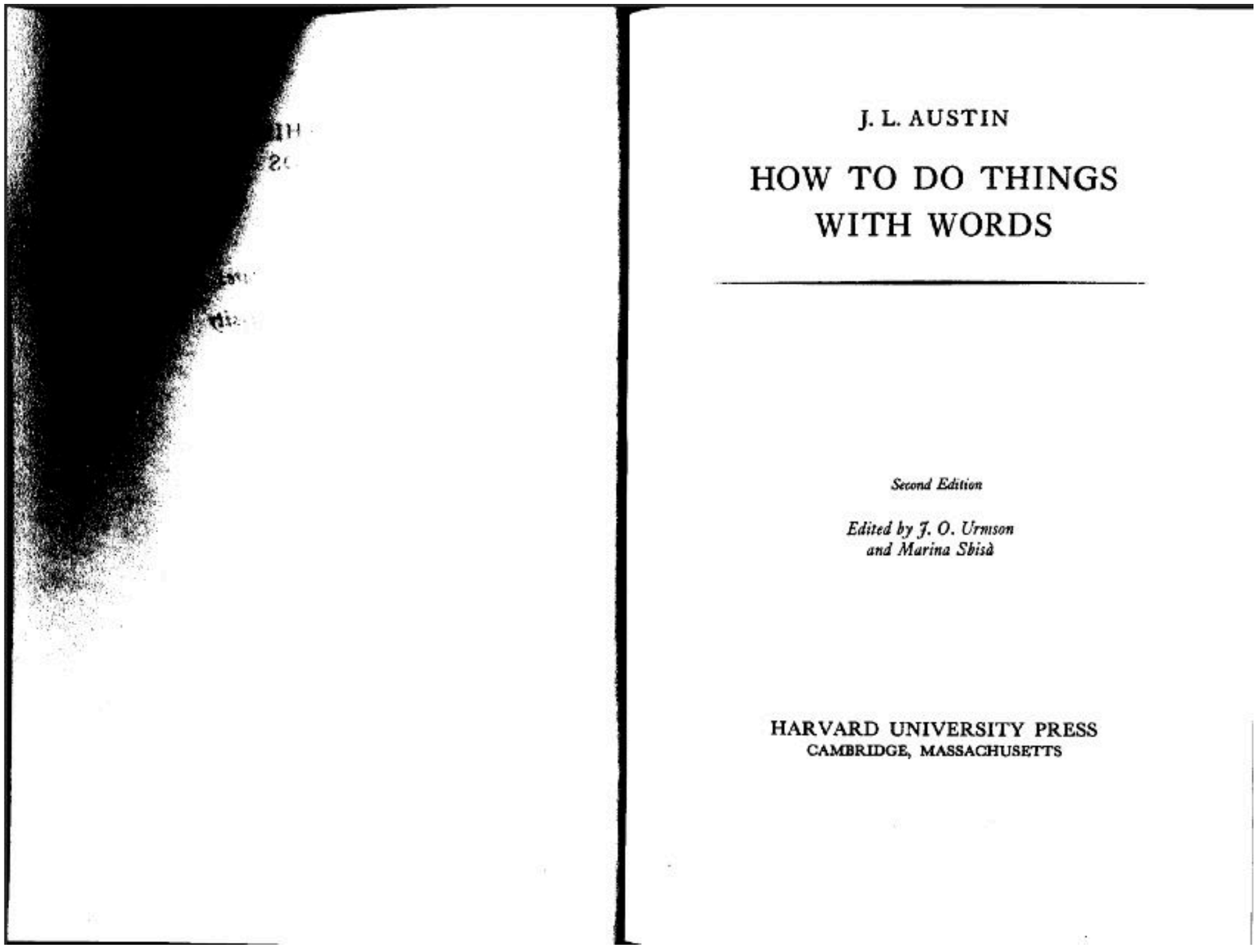

J. L. AUSTIN

HOW TO DO THINGS WITH WORDS

Second Edition

Edited by J. O. Urmson
and Marina Sbisà

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JEROME BRUNER

Acts of Meaning

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Bruner's theory

Bruner developed a model for the way children turn experiences into knowledge

The 3 stages of the model is;

1. Enactive mode – children represent and understand using physical actions. They act out experiences to learn & remember
2. Iconic – children will use one thing to represent something else or create their own images
3. Symbolic – children are able to represent and understand the world round them using words & ideas. They don't need to act out or use objects when expressing experience

Baker, B. Et Al, 2102:321

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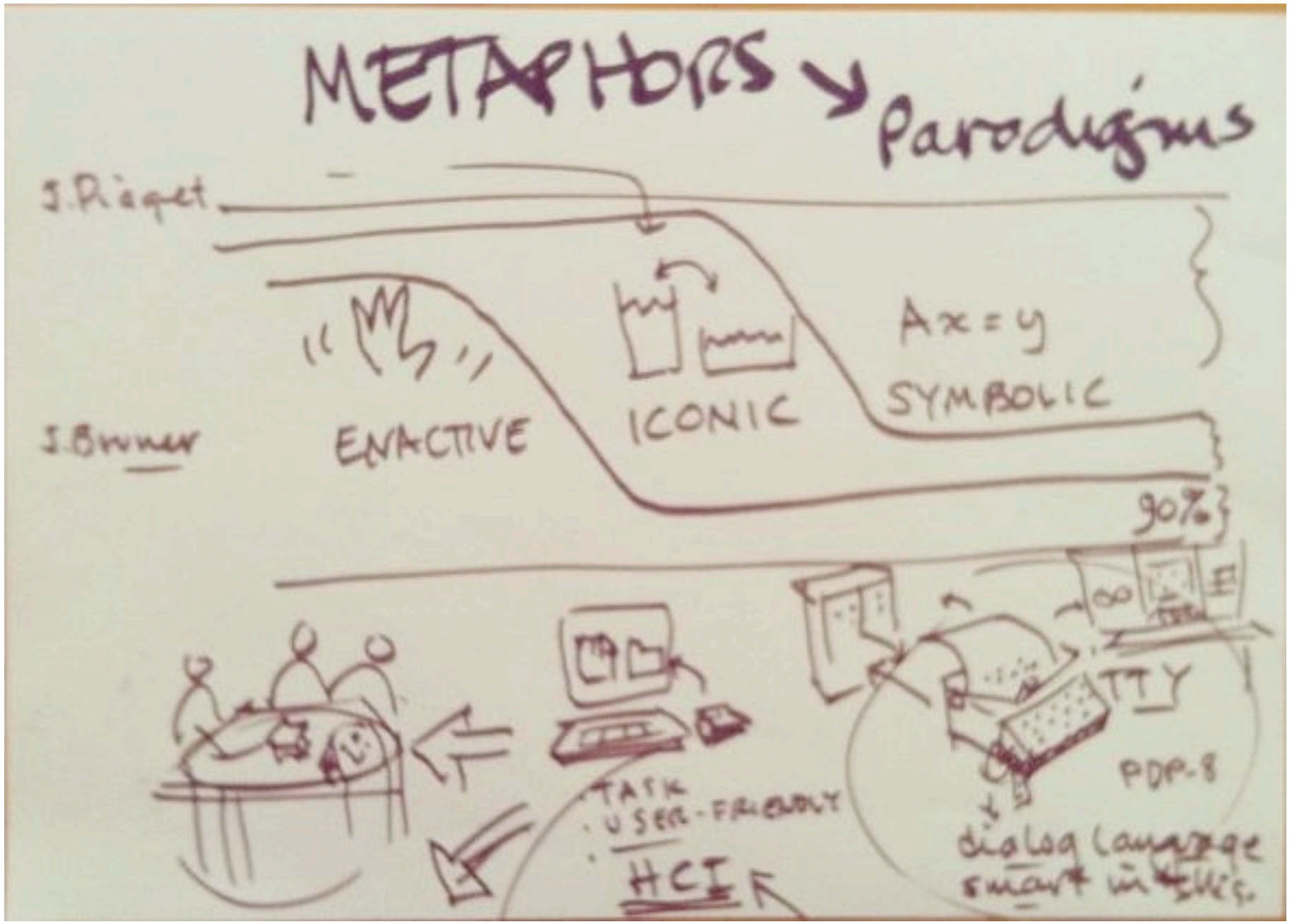
William Verplank



http://blog.lauramalinverni.org/?p=99

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Symbolic
Iconic knowledge
Enactive

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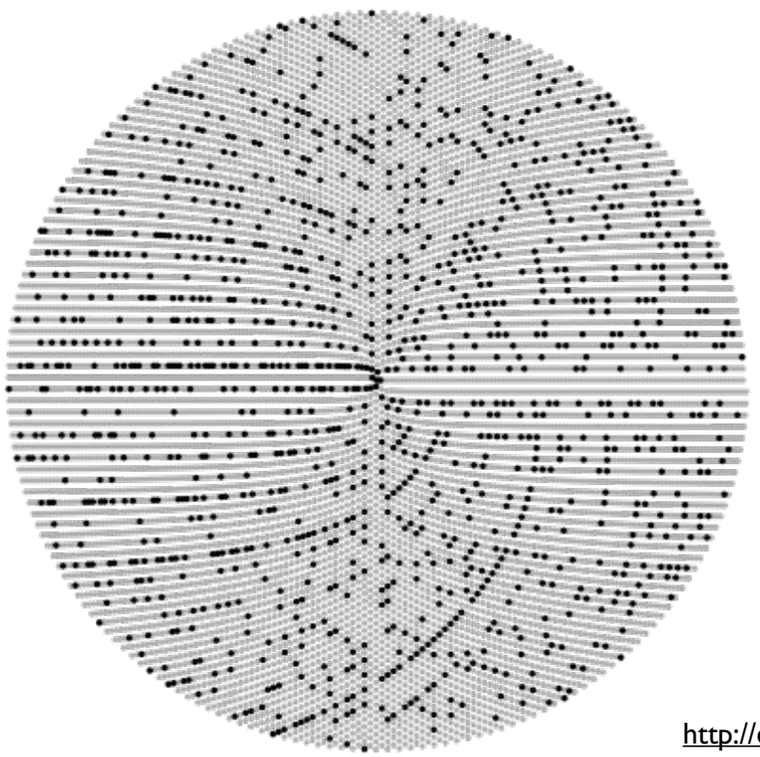

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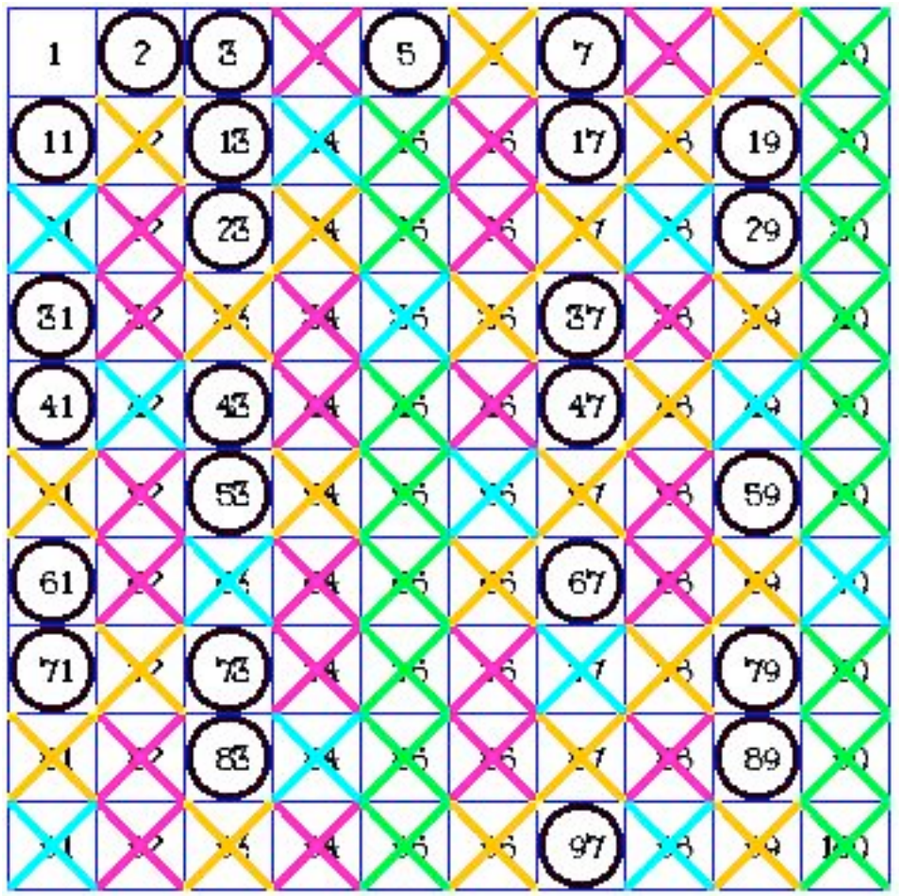

Sieve of Eratosthenes

https://scratch.mit.edu/projects/2390886/

http://en.wikipedia.org/wiki/Ulam_spiral#Sacks_spiral

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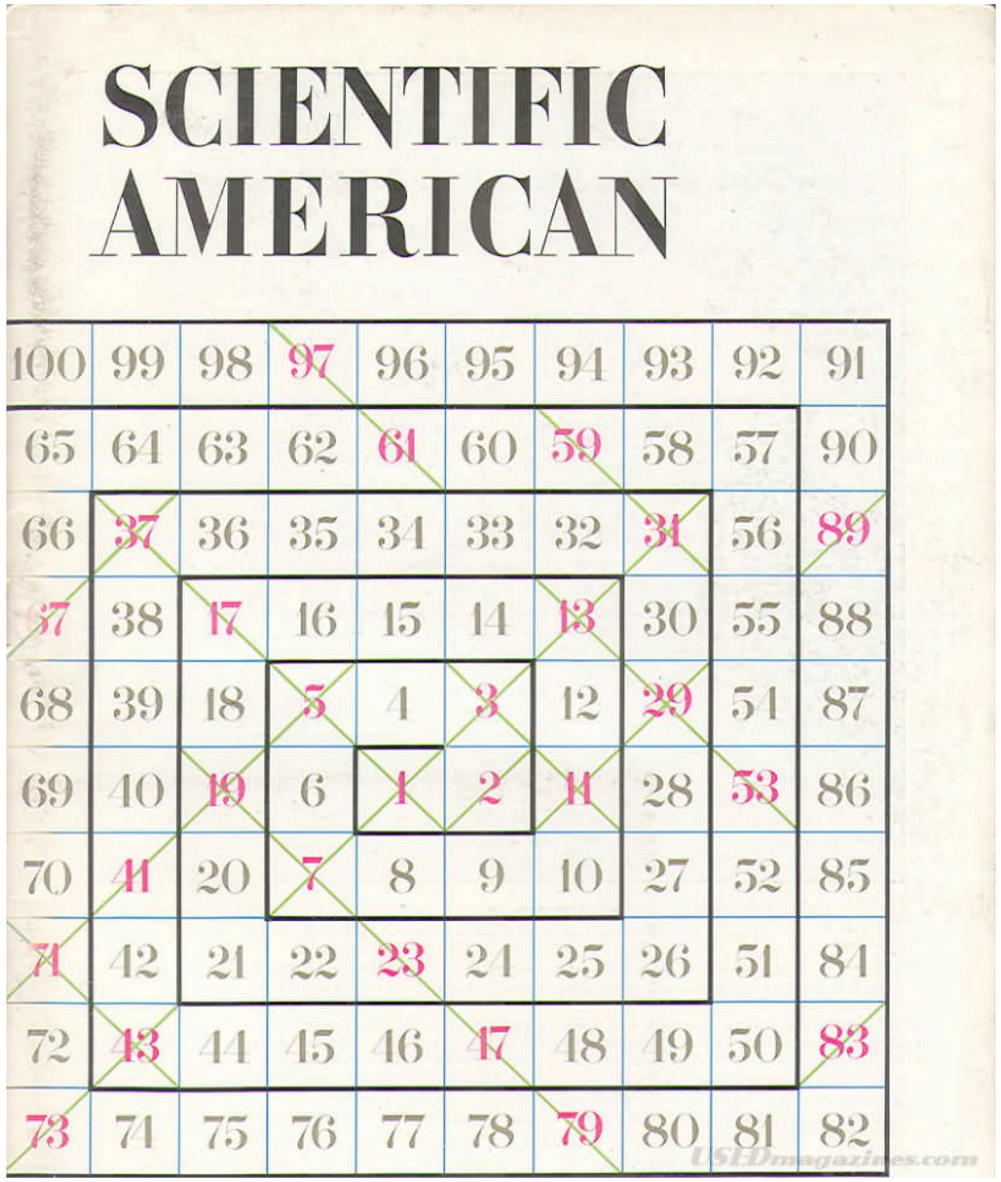

ULAM FEYNMAN VON NEUMANN

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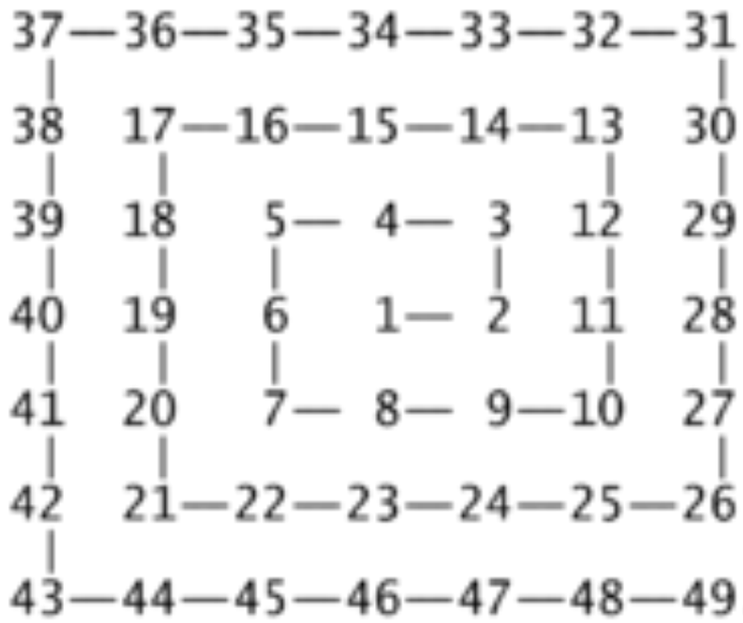

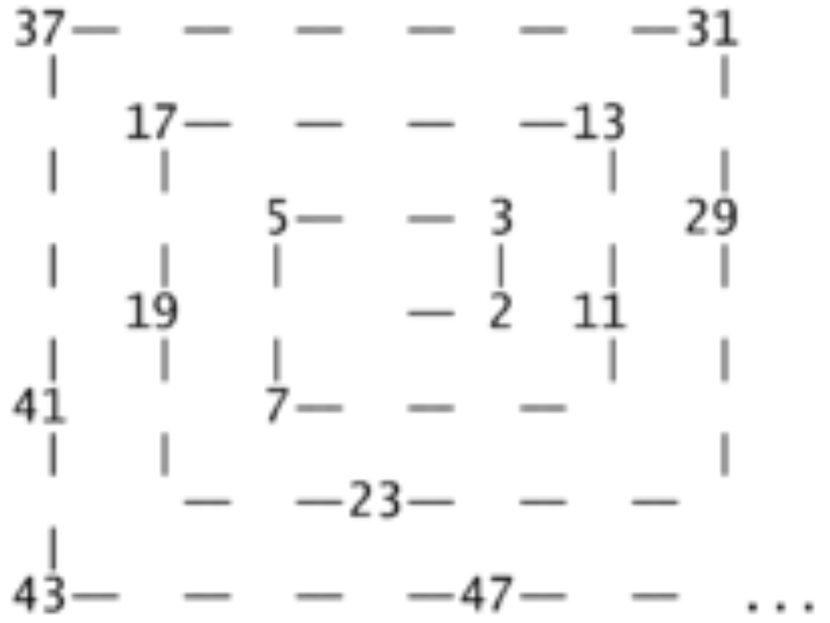

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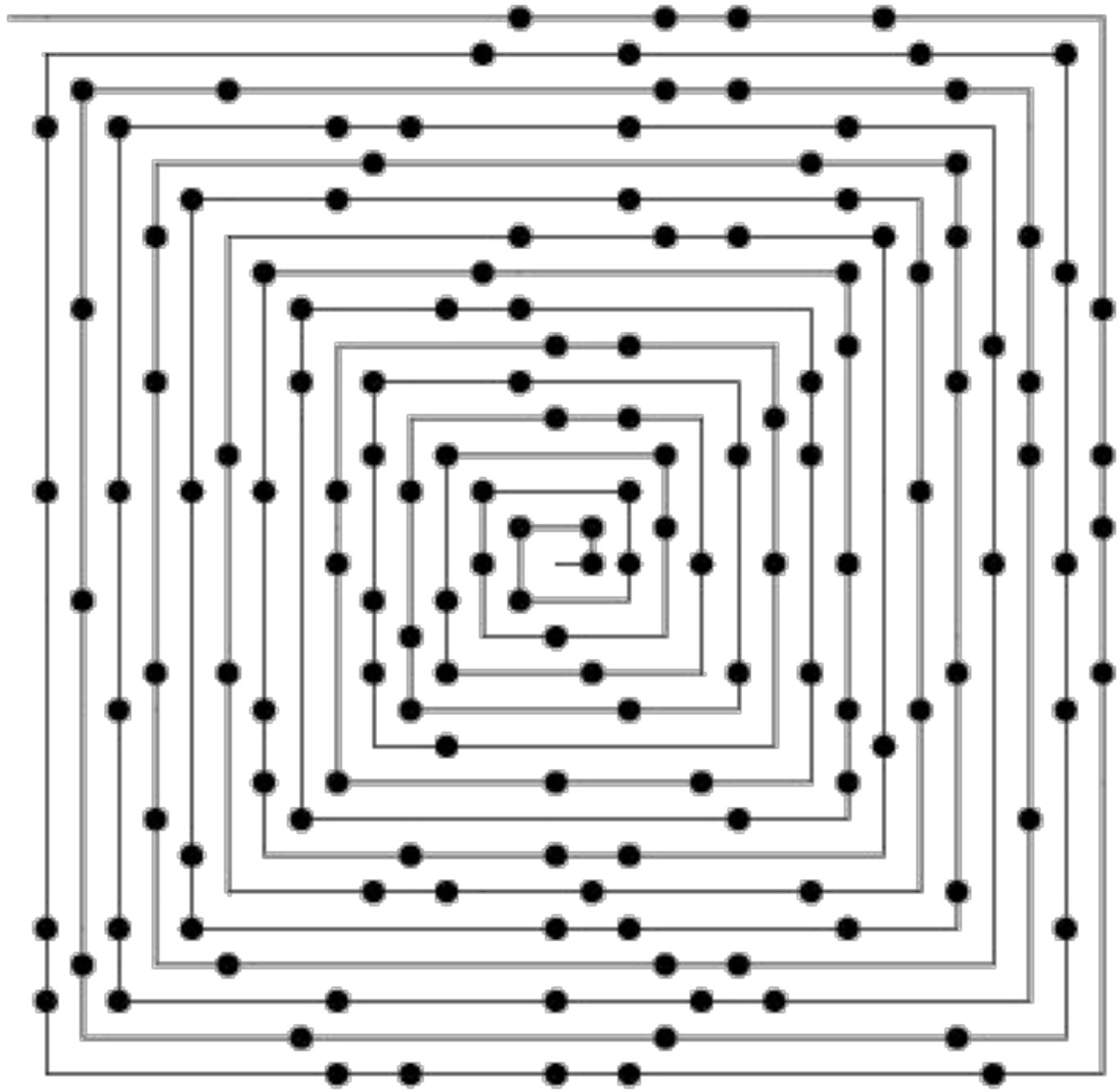

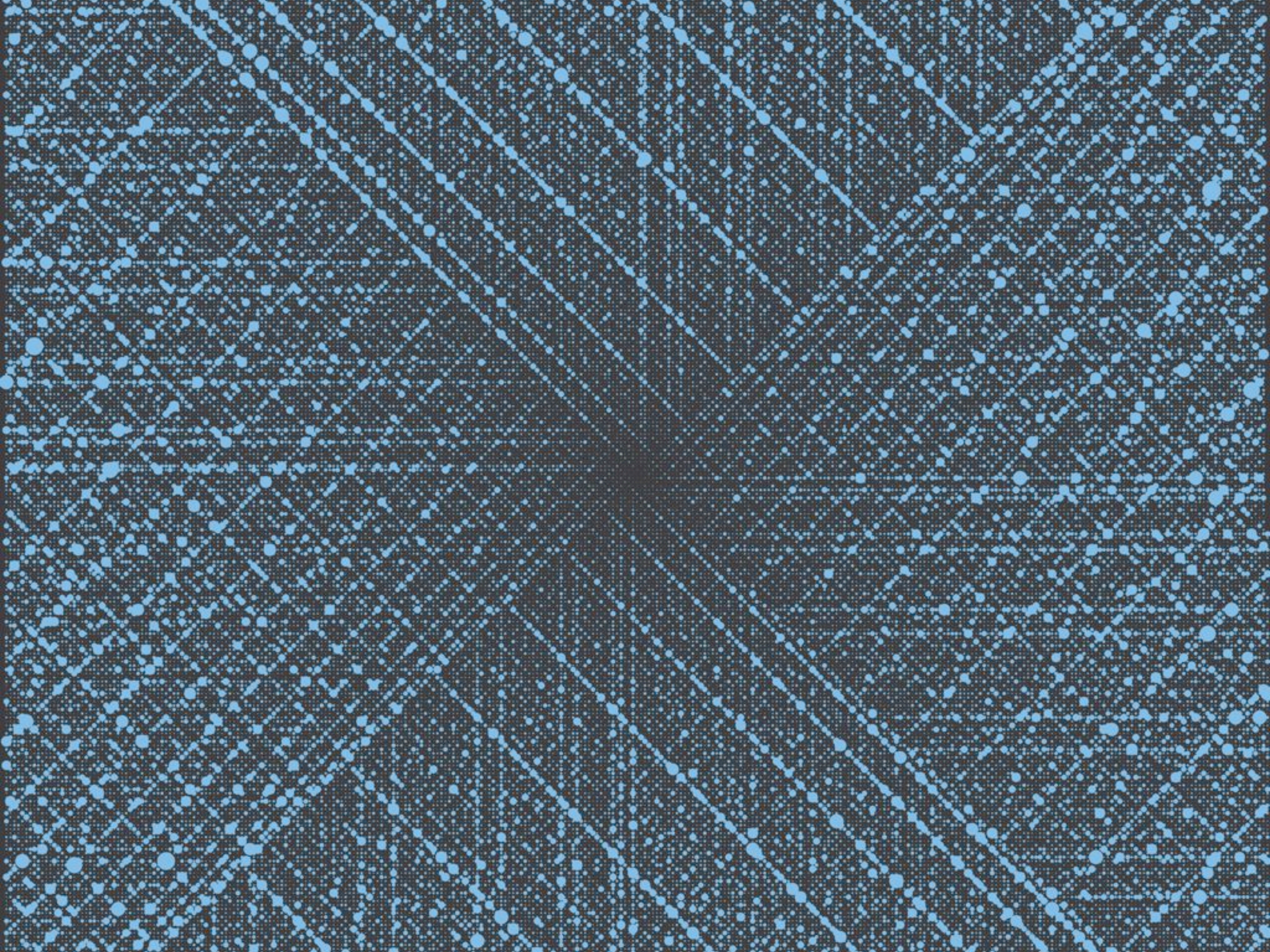

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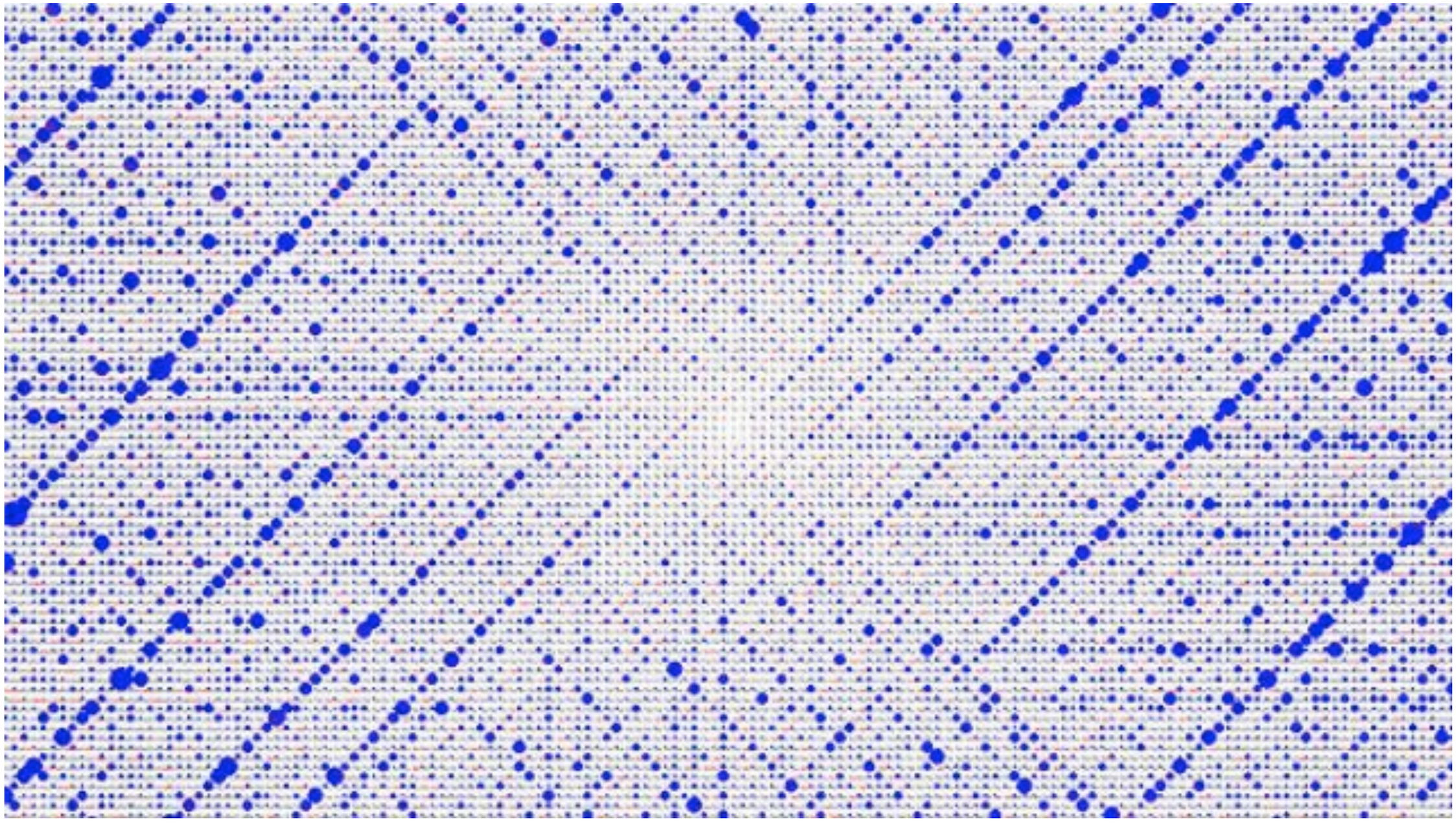

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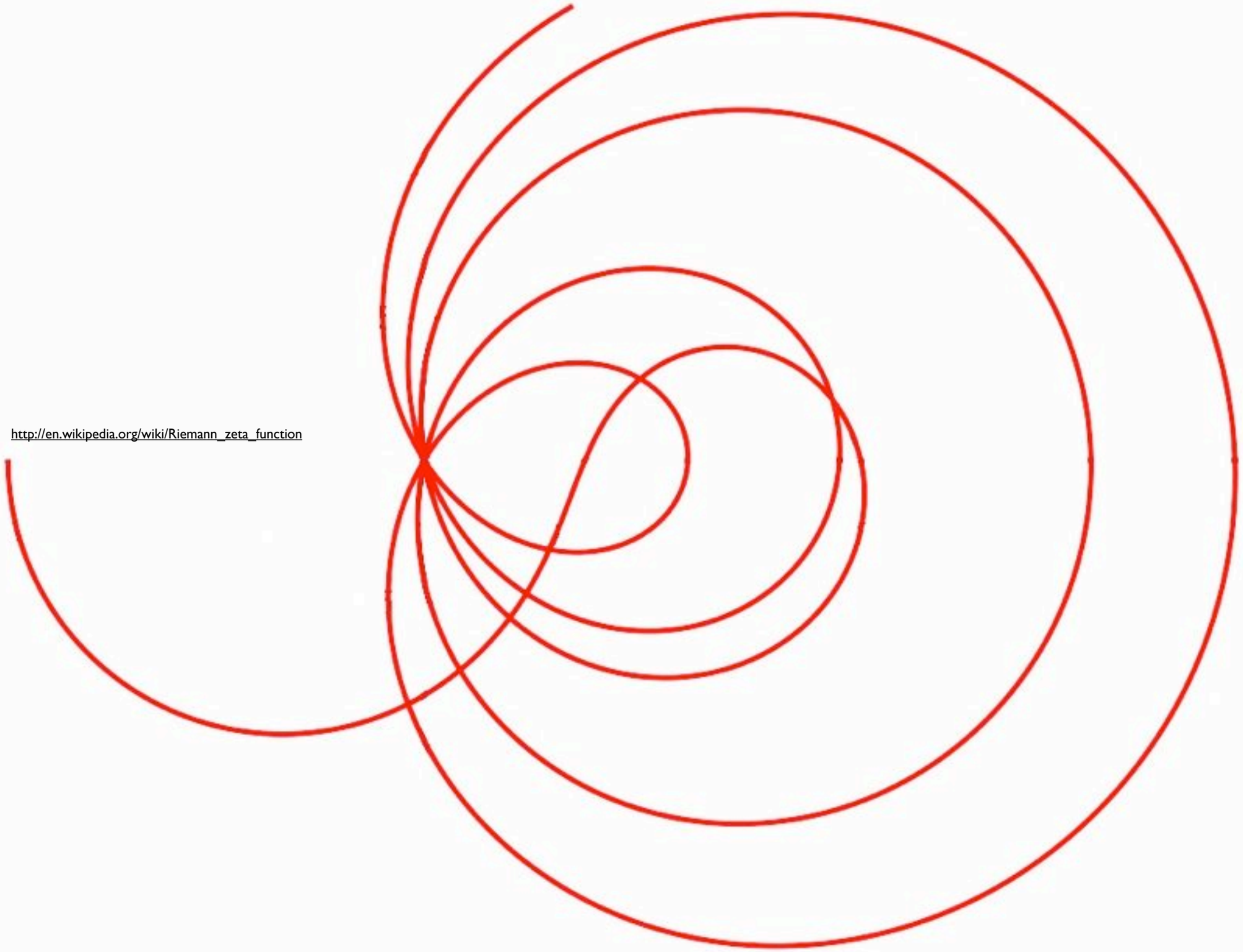
http://en.wikipedia.org/wiki/Riemann_zeta_function



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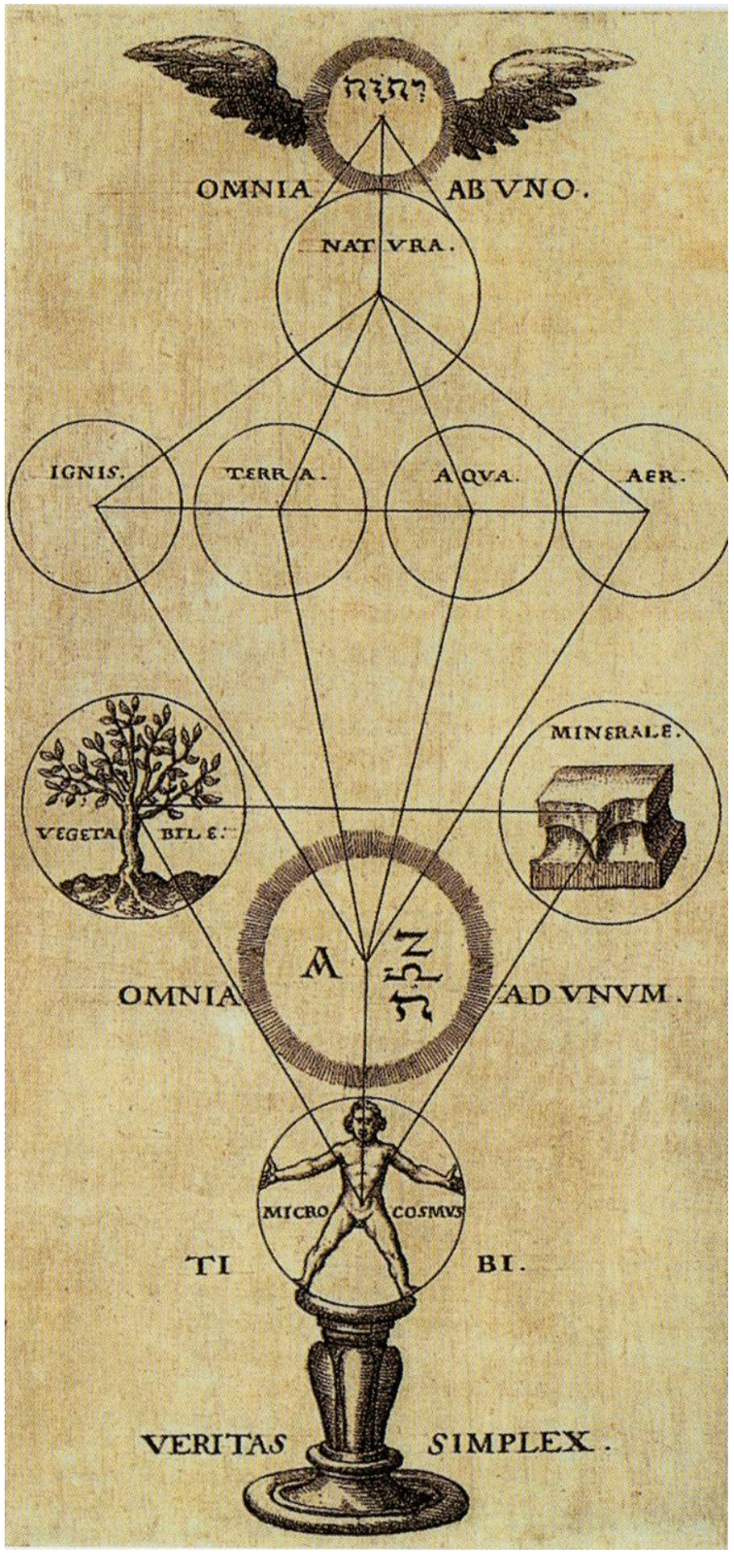
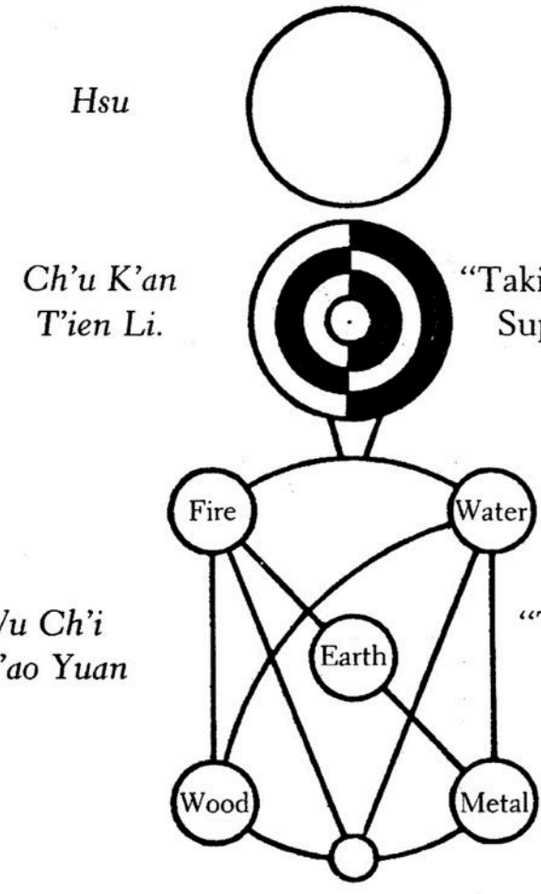


Diagram Of The Ultimateless
Wu Chi T'u

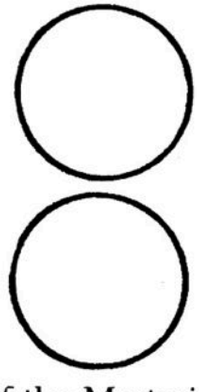


Hsu — Void

Ch'u K'an T'ien Li. — "Taking from *K'an* to Supplement *Li.*"

Wu Ch'i Ch'ao Yuan — "The Five Forces Assembled at the Source."

Lien Ching Hua Ch'i; Lien Ch'i Hua Shen. — "Transmuting the Essence so as to Transform It into the Vital Force; Transmuting the Vital Force so as to Transform It into the Spirit."



"Doorway of the Mysterious Female"
Hsuan P'in Chih Men

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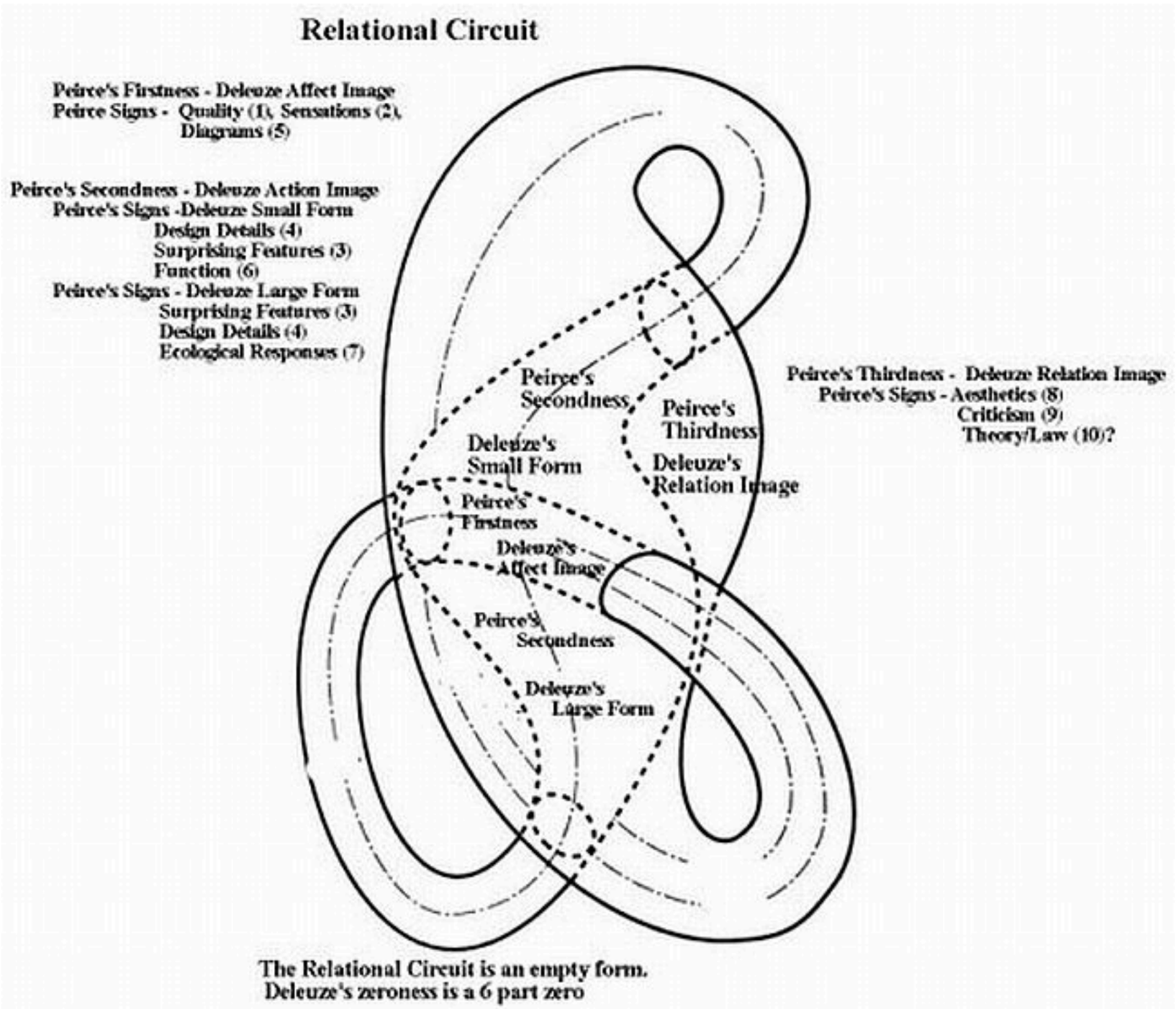

The Relational Circuit is an empty form.
Deleuze's zeroness is a 6 part zero

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Peirce Dicisigns

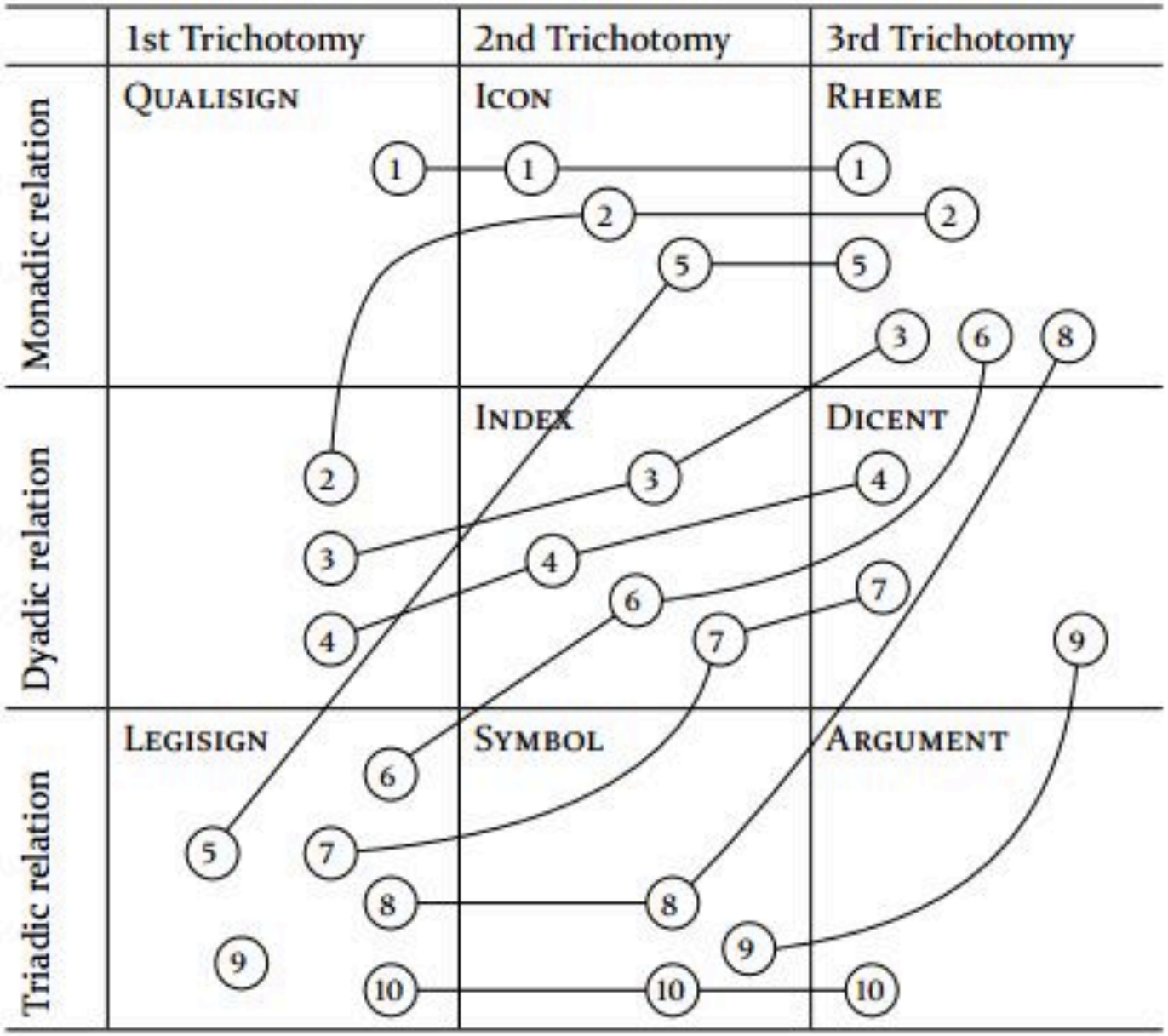

Figure 1. *The 10 classes of signs as a system of cross-relational classes. The paths correspond to the possible compounds of relations (figure based on 'Table 1', Merrell 1996: 8).*

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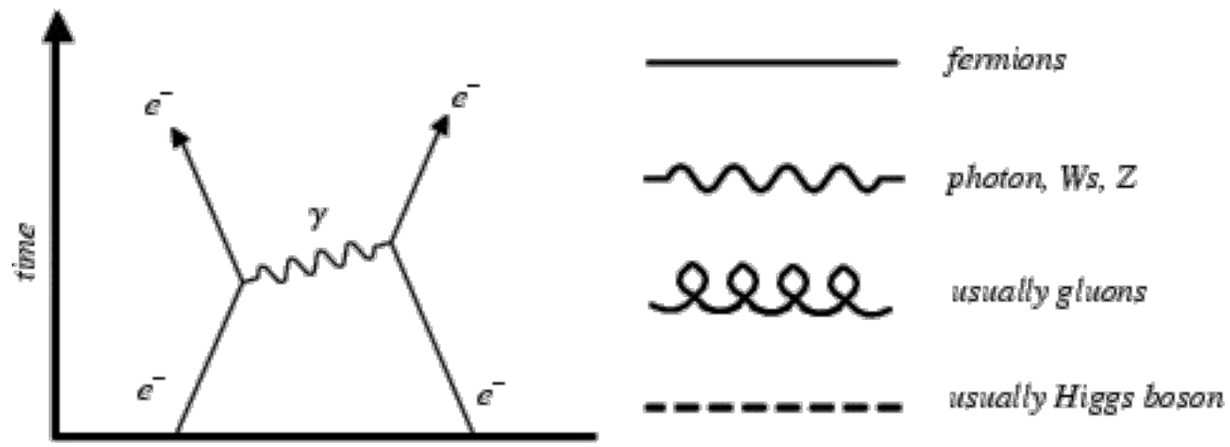

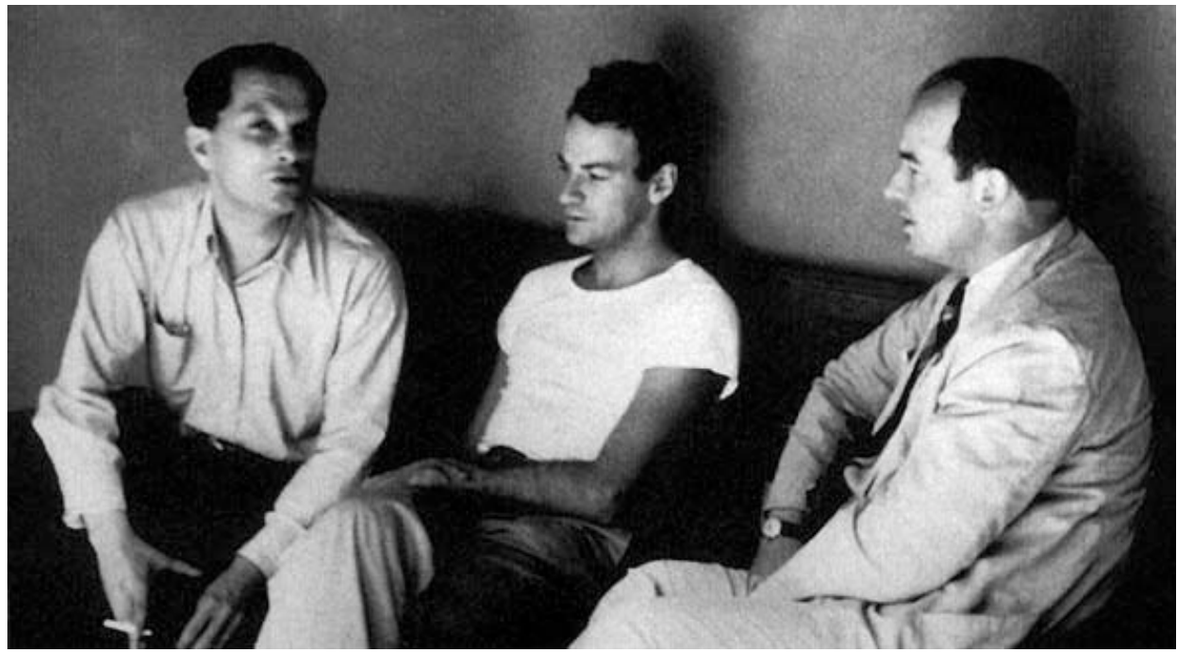

ULAM **FEYNMAN** VON NEUMANN

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Symbolic
Iconic resonance
Enactive

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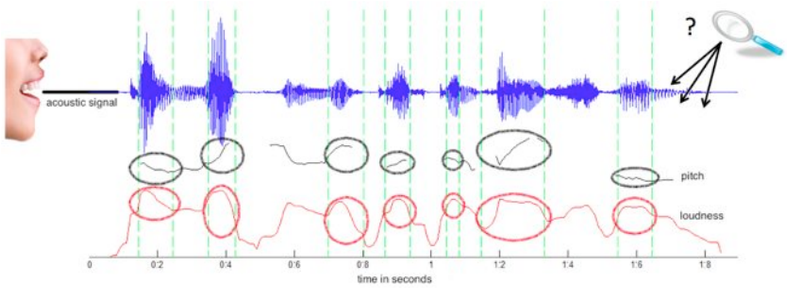
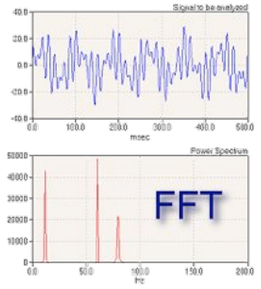
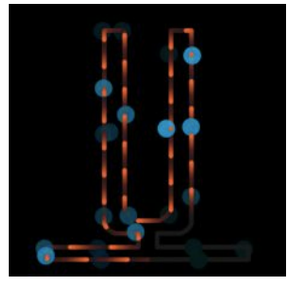
Text or Verbalised word → Prosody → FFT → 3D Model → Virtual Shape → Physical Shape





$$M = \begin{pmatrix} a_{11} & a_{12} & a_{13} & \dots & a_{1m} \\ a_{21} & a_{22} & a_{23} & \dots & a_{2m} \\ a_{31} & a_{32} & a_{33} & \dots & a_{3m} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ a_{n1} & a_{n2} & a_{n3} & \dots & a_{nm} \end{pmatrix}$$



SYMBOLIC → *ICONIC* → *ENACTIVE*

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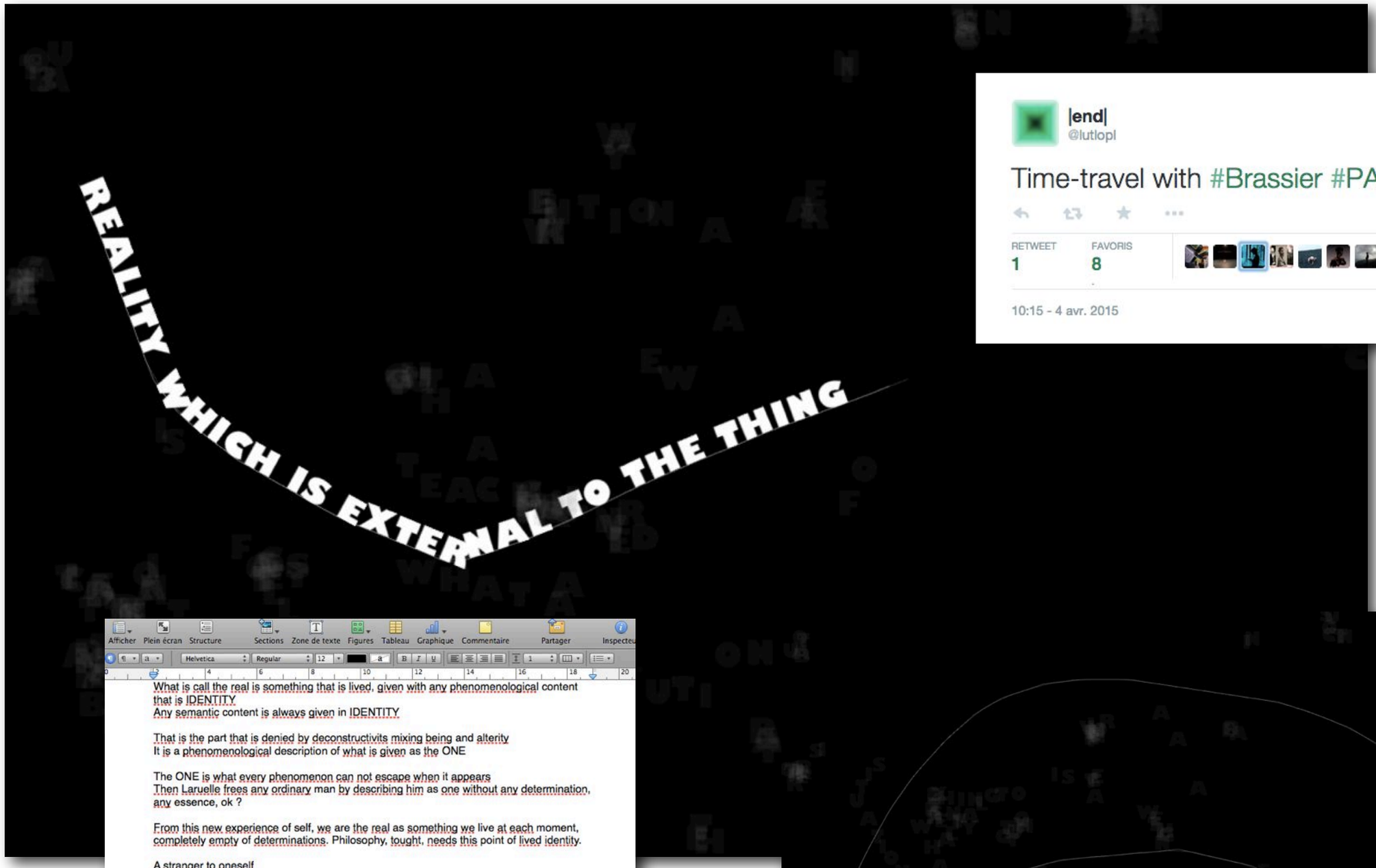

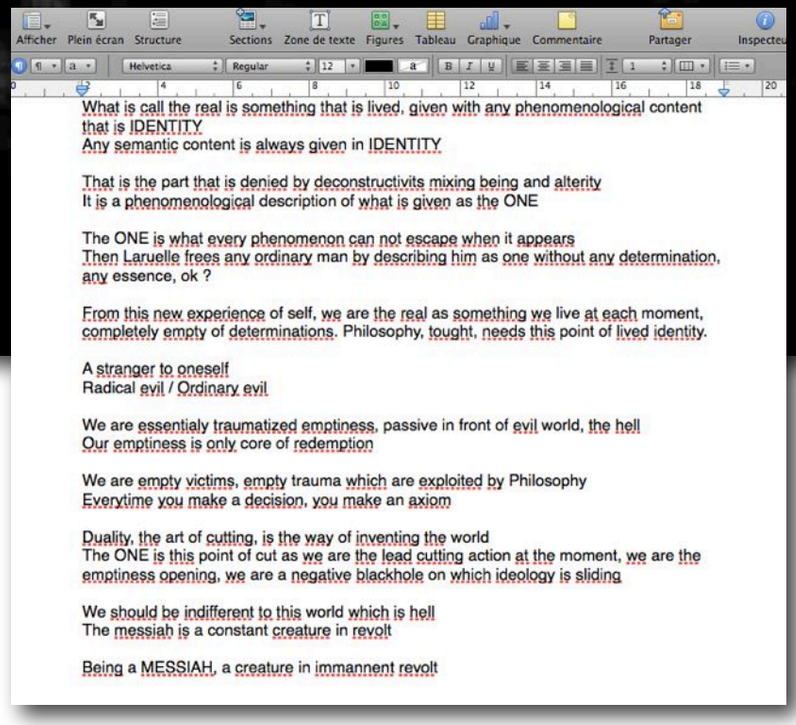

What is call the real is something that is lived, given with any phenomenological content that is IDENTITY
Any semantic content is always given in IDENTITY

That is the part that is denied by deconstructivits mixing being and alterity
It is a phenomenological description of what is given as the ONE

The ONE is what every phenomenon can not escape when it appears
Then Laruelle frees any ordinary man by describing him as one without any determination, any essence, ok ?

From this new experience of self, we are the real as something we live at each moment, completely empty of determinations. Philosophy, tought, needs this point of lived identity.

A stranger to oneself
Radical evil / Ordinary evil

We are essentialy traumatized emptiness, passive in front of evil world, the hell
Our emptiness is only core of redemption

We are empty victims, empty trauma which are exploited by Philosophy
Everytime you make a decision, you make an axiom

Duality, the art of cutting, is the way of inventing the world
The ONE is this point of cut as we are the lead cutting action at the moment, we are the emptiness opening, we are a negative blackhole on which ideology is sliding

We should be indifferent to this world which is hell
The messiah is a constant creature in revolt

Being a MESSIAH, a creature in immannent revolt

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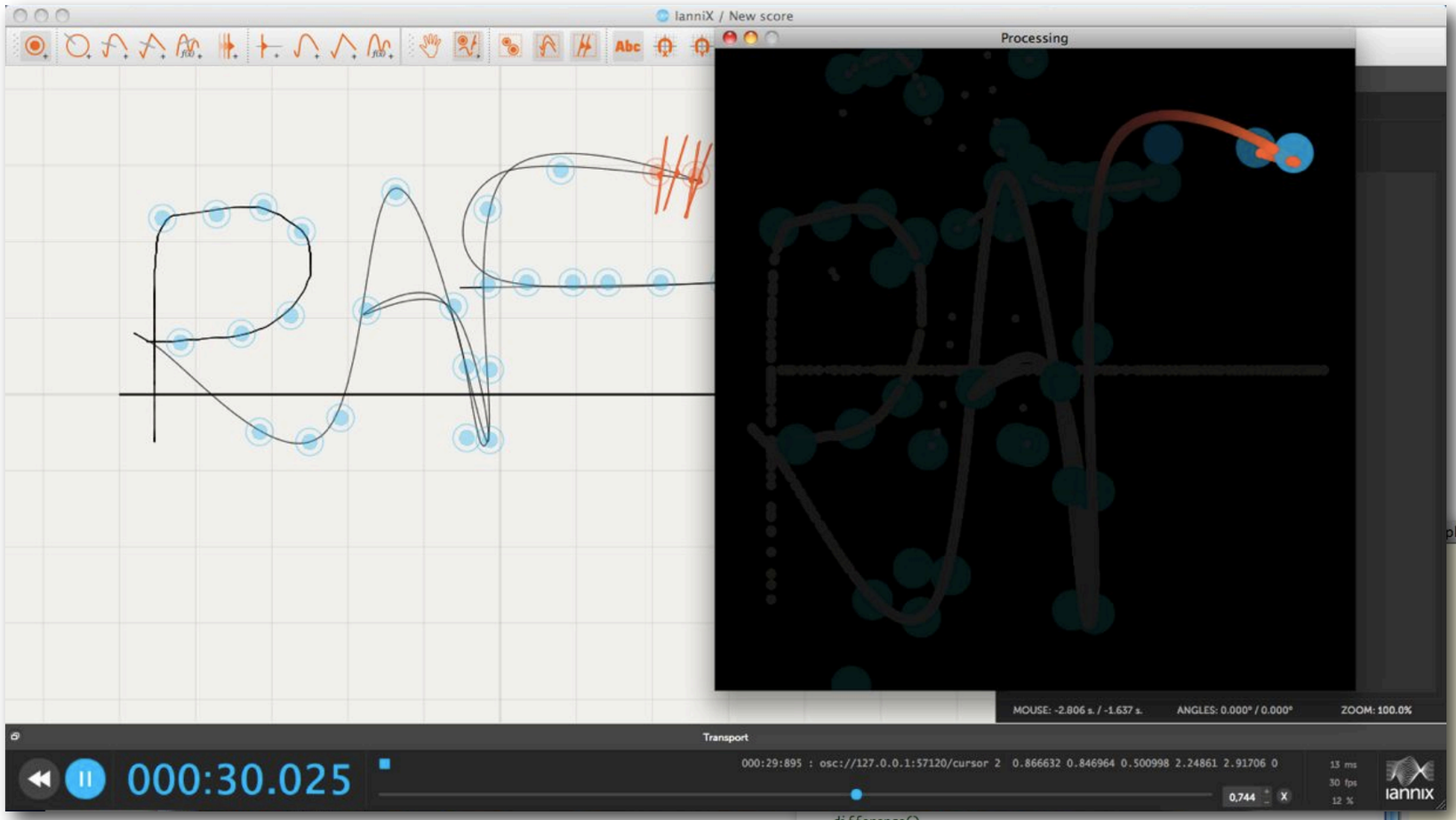
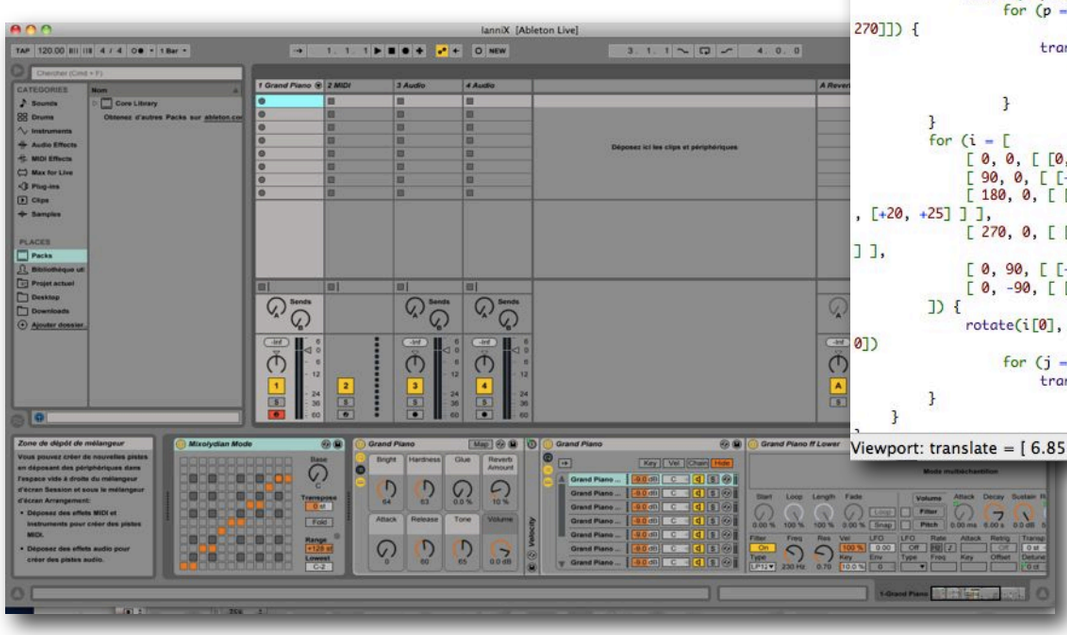
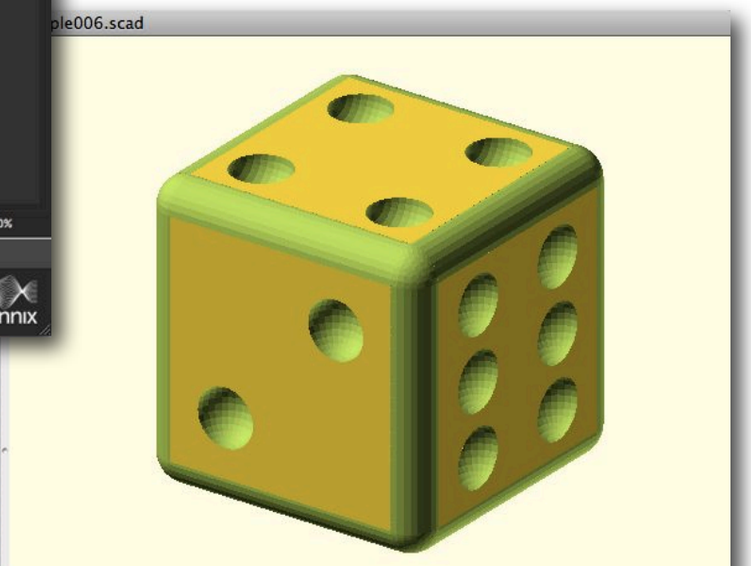





```
difference()
{
    cube(100, center = true);
    for (rot = [ [0, 0, 0], [1, 0, 0], [0, 1, 0] ]) {
        rotate(90, rot)
            for (p = [[+1, +1, 0], [-1, +1, 90], [-1, -1, 180], [+1, -1,
270]]) {
                translate([ p[0]*50, p[1]*50, 0 ])
                    rotate(p[2], [0, 0, 1])
                        edgeprofile();
            }
    }
    for (i = [
        [ 0, 0, [ [0, 0] ] ],
        [ 90, 0, [ [-20, -20], [+20, +20] ] ],
        [ 180, 0, [ [-20, -25], [-20, 0], [-20, +25], [+20, -25], [+20, 0]
, [+20, +25] ] ],
        [ 270, 0, [ [0, 0], [-25, -25], [+25, -25], [-25, +25], [+25, +25]
] ],
        [ 0, 90, [ [-25, -25], [0, 0], [+25, +25] ] ],
        [ 0, -90, [ [-25, -25], [+25, -25], [-25, +25], [+25, +25] ] ]
    ]) {
        rotate(i[0], [0, 0, 1]) rotate(i[1], [1, 0, 0]) translate([0, -50,
0])
            for (j = i[2])
                translate([j[0], 0, j[1]]) sphere(10);
    }
}
```

Viewport: translate = [6.85 1.27 4.66], rotate = [64.10 0.00 125.80], distance = 921.22




```
Module cache size: 0 modules
Compiling design (CSG Tree generation)...
Compiling design (CSG Products generation)...
PolySets in cache: 11
PolySet cache size in bytes: 142648
CGAL Polyhedrons in cache: 8
CGAL cache size in bytes: 3929808
Compiling design (CSG Products normalization)...
Normalized CSG tree has 34 elements
CSG generation finished.
Total rendering time: 0 hours, 0 minutes, 7 seconds
```

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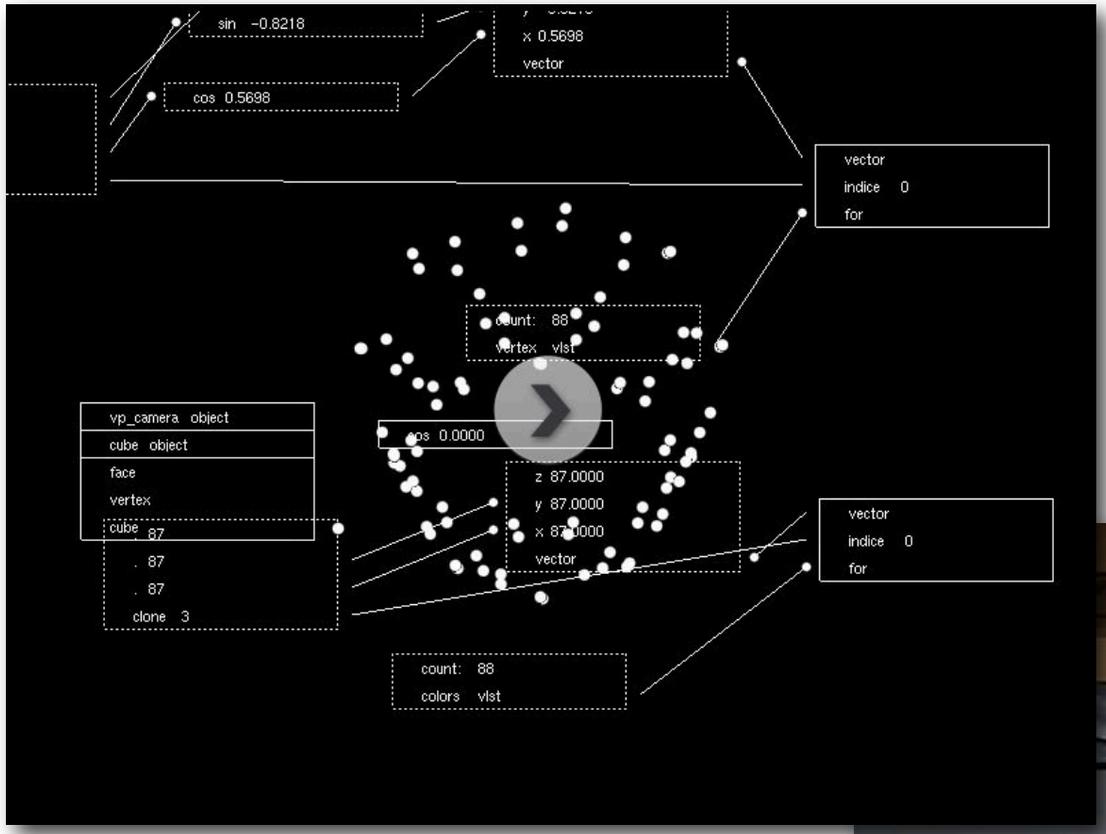
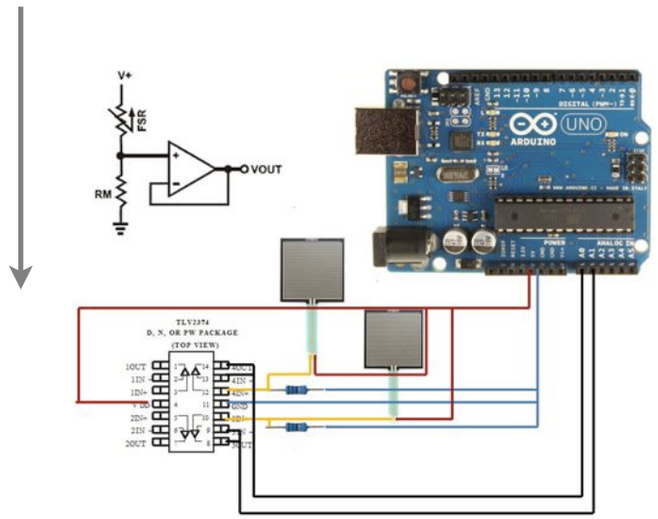
Minuit RVBA





Fluxus + Minuit + OSC + GCode + I/O

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http://www.tms.org/pubs/journals/jom/0511/burleigh-0511.html

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Shamanism

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COLORS

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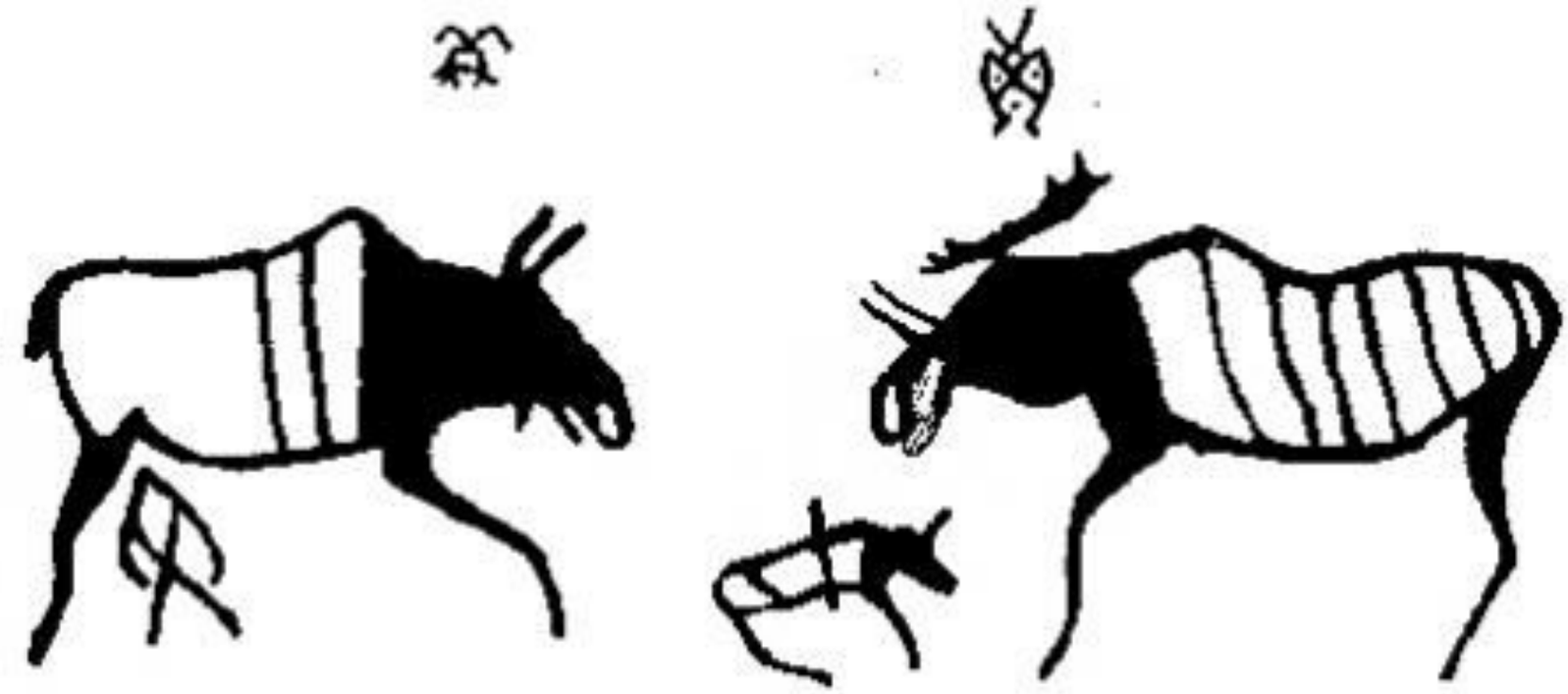
Langue des Oiseaux Bird Language



Deers from Tojon Aryy

http://emscat.revues.org/1606

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PLAYING

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Pretend Play in Animals

Lions pretend to be hurt by the bites of their young to encourage them.

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SUPRANATURAL

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Tengrism

Unlike other regions of the world today, Northern Asia— the world of the steppe, taiga and tundra — seems to be sheltered from upheavals. Let us take the example of the native people of Siberia: the dying out of the Soviet regime and the change over to the market economy are carried out in a comparative apathy (except for anti-Russian acts of violence at Tuva). This vast zone is hardly talked about.

Does it mean that it remains outside globalization? Far from it. But it has remained closed and isolated for so long that the sentiment of discovery prevails, for those who enter into it or leave it. Even if tourism devel s especially because of the journalists, ecologist militants or New Age travelers. And even if the trip abroad has become possible for these people, only some of their elites have access to it, like the singing and dancing troops invited to make tours throughout the world.

Nevertheless, an Arctic belt was made: the 'small people of the North' visit those they think are distant cousins in the American continent, to learn how to defend their territorial rights and claim their share of natural wealth. Their topicality is made from a complex mixture of 'return to traditions' and acce ver be the political situation: national minority or titular ethnic group of an autonomous republic in Russian Federation, titular e ally independent like Mongolia.

The 'return to the traditions' is, since 1990, a major theme with al one are the days of eradication of customs, condemnation of religions, obligation of conforming to Homo sovieticus model, hu

Because many old ideas and habits have endured under the glaz loyal to themselves under the flow of successive slogans. Some resurface as soon as the possibility of laying claims on them ope ing back to it. It is the same at all levels in all realms. The lapse dying out in the collective economy and automatic salary pushes

But the organization of labor in kolkhozs, sovkhozs and others h tion has offered professional training education for women, which dissuades the women themselves and their children from n resorting to old way of life and qualified women, between two claims of 'authenticity' —city dweller intellectuals appearing as th

The Siberian peoples, who did not have a State of their own befo el. Not long ago they claimed to be tuva (or koriak or evenk) and soviet at the same time; such a plurality is not anymore possible ut, being initially shamanists, they were long ago more or less converted to orthodox Christianity, Buddhism or Islam, then subj

Then, which religion to invoke? Confronted with this problem, th nomous Republics of their own (without being majority there) are most strongly motivated to exercise their creativity. In fact, th titular ethnic group to create a new national identity for themselves on a territorial basis. Thus the Yakut intellectuals hav riptions of Russian observers of the end of the 19th century.

In Buryatia it is the most famous epic hero, Geser (like Manas in l , thanks to the academic support and the creation of a specific ministerial department, institutions, publications and festivities t y we see new attempts emerging, like tengrianstvo in Khakassia, Kirghizia, Yakutia…

This recent neologism follows classical tengrism, formed on the turco-mongol word tengri 'sky'. It takes the concept of ‘mandate of the sky' used at the medieval time by the empires of the steppes to found their legitimacy. Some historians have interpreted this 'sky' as a supreme religious reference, although it was not conceived as a personal god and did not receive any direct cult. Nowadays involving this old concept is to equip the political unit with a religious tool of legitimization. A form of tengrianstvo just appeared even in Mongolia, superimposing on the unifying figure of Gengis Khan, who dominates the symbolic life of the nation since 1990, and enjoys a cult where Shamanic and Buddhist elements mix.

We observe constant aspects which recall the Soviet ways in the creativity deployed for (re)-constructing ethnic or national identity, but adapted to other ideals: the quasi experimental character of innovations which favor their quick succession, their elaborate ritualization intended to make them familiar, the practice of commemoration that enables to reconstruct history. A particular role comes back to Shamanism in this articulation between 'return to traditions' and modernization. Giving rise to a 'mystical tourism' on behalf of the Westerners, which is reflected locally in diverse forms (neo-Shamanisms the western way, urban Shamanism with nationalist tendency), it joins the liberalism based on

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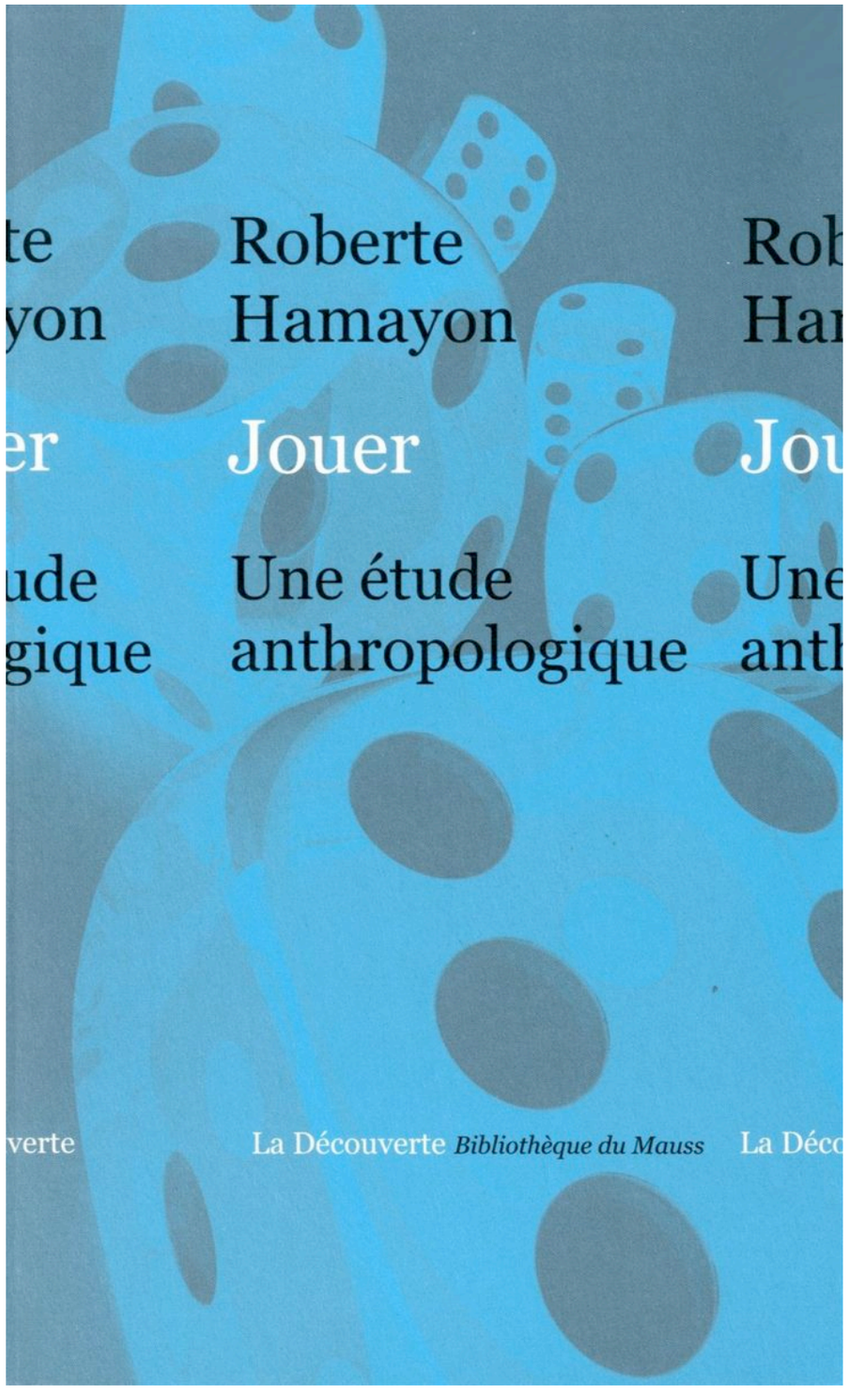

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Tensegrity

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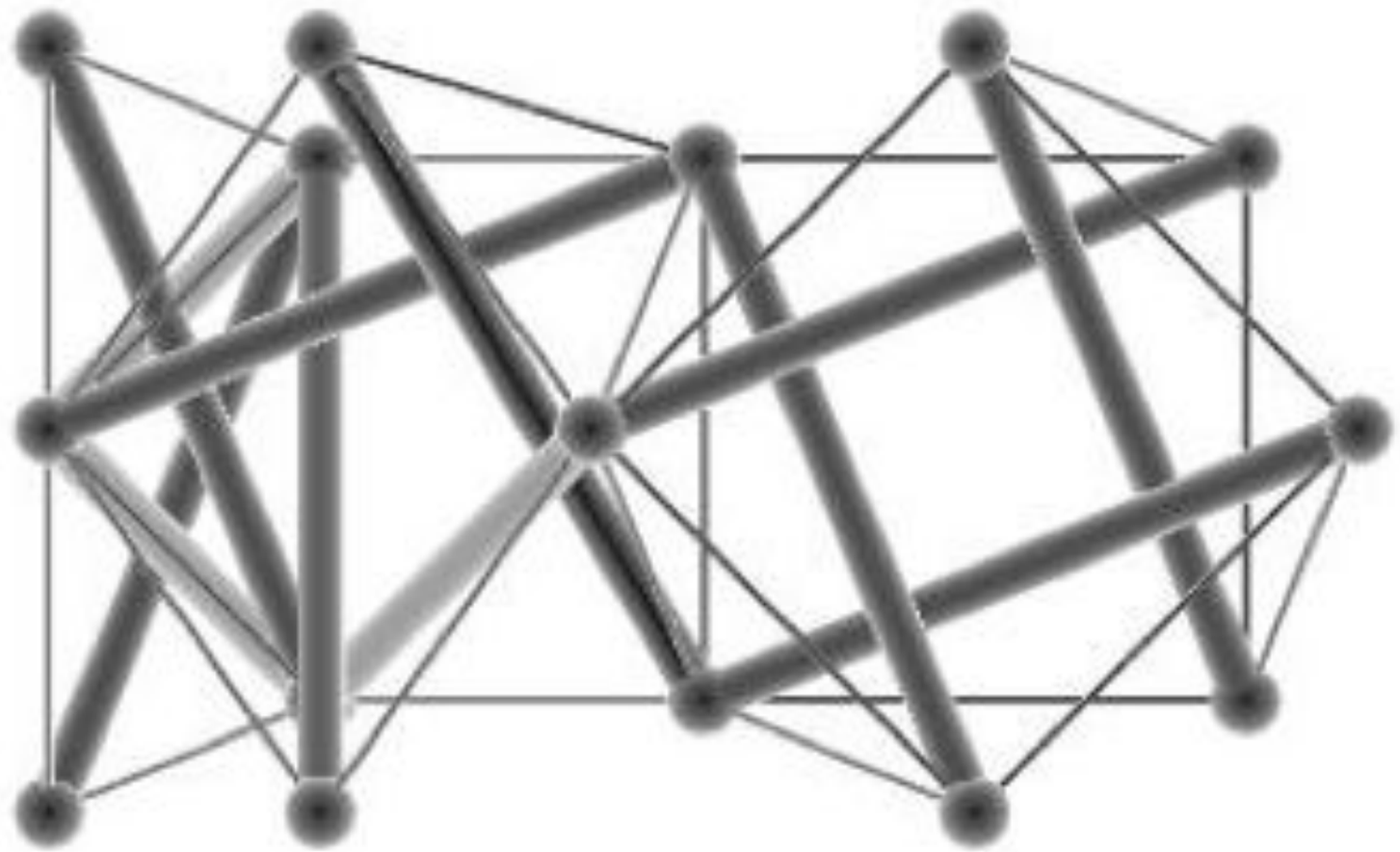

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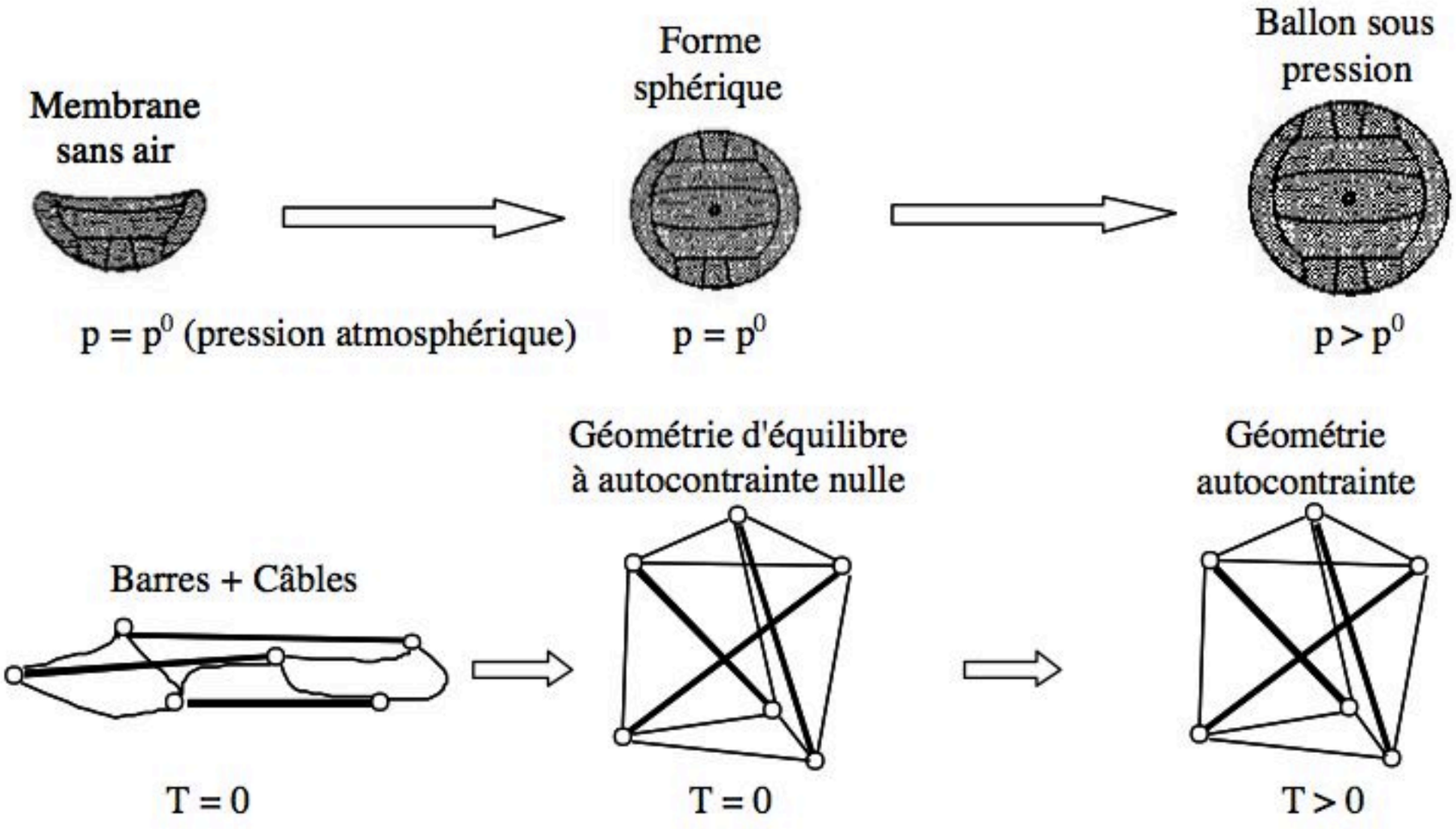

Figure 4 : Analogie entre la mise en pression d'un ballon et la mise en autocontrainte d'un système de tenségrité.

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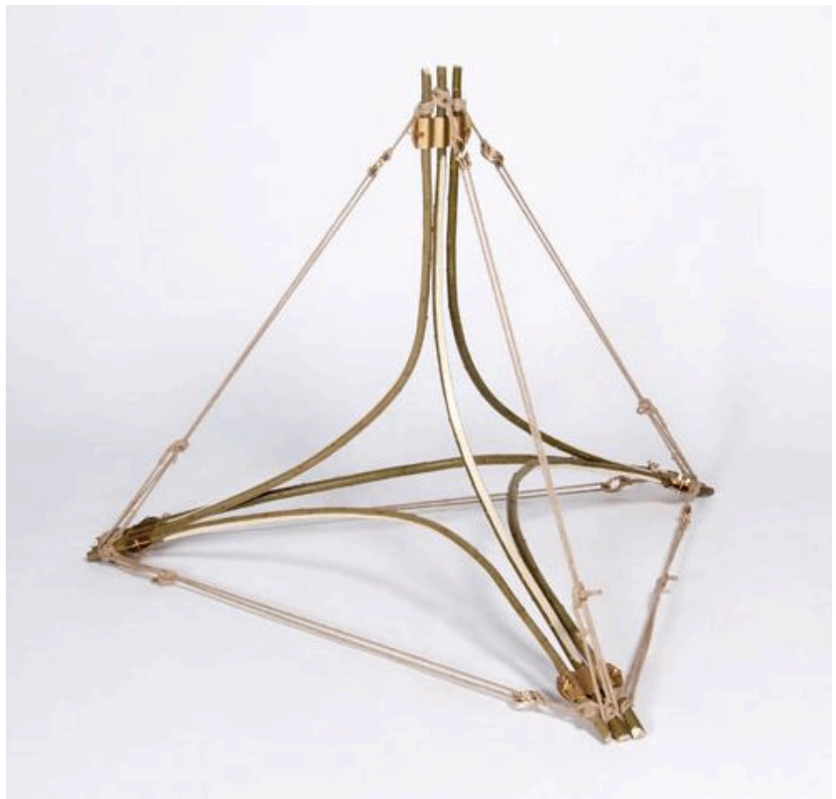

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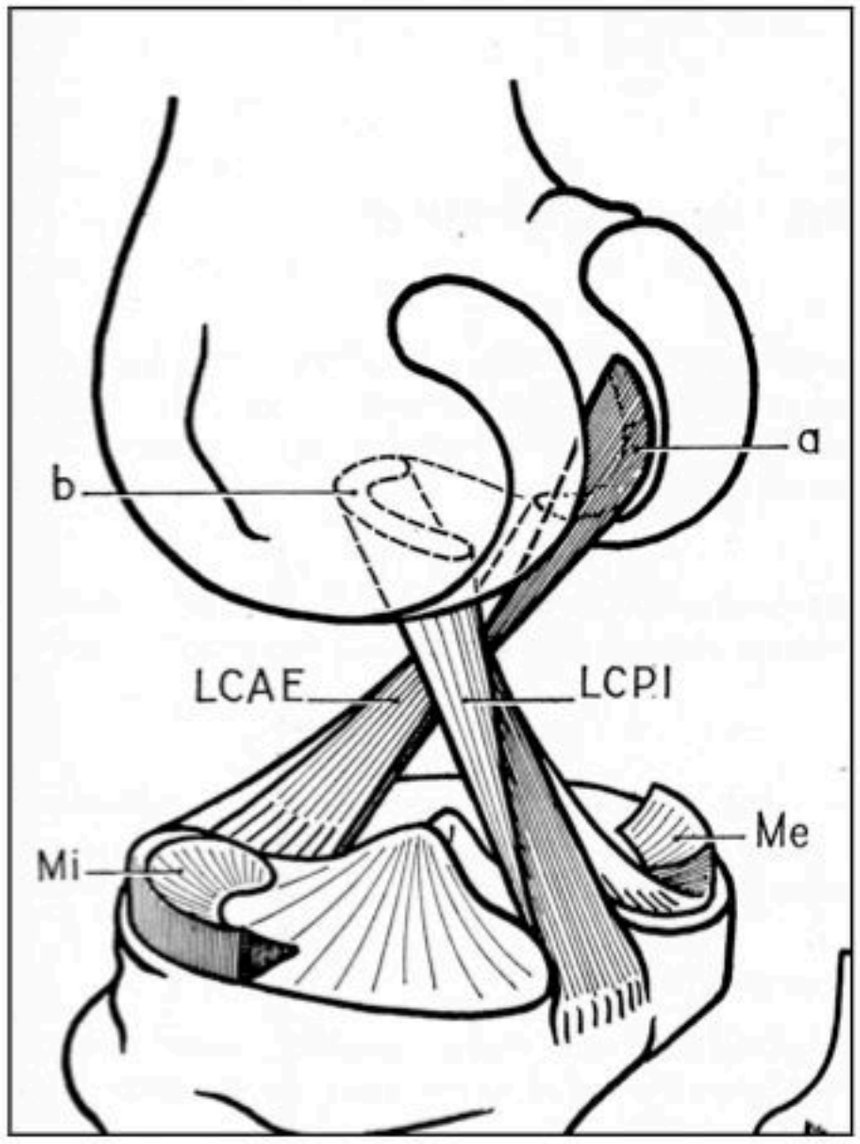

Figure 3.18 : Ligaments croisés du genou [50].

Figure 3.19 : "X. Piece", K. Snelson (1949) [97].

L'analogie entre la sculpture et l'architecture du genou est frappante, les cables matérialisant les ligaments, toujours en tension. L'œuvre du plasticien illustre à merveille le concept ostéopathique de tension réciproque (sur un mode statique). Le rôle du principe de tenségrité en physiologie articulaire mérite ainsi d'être précisé.

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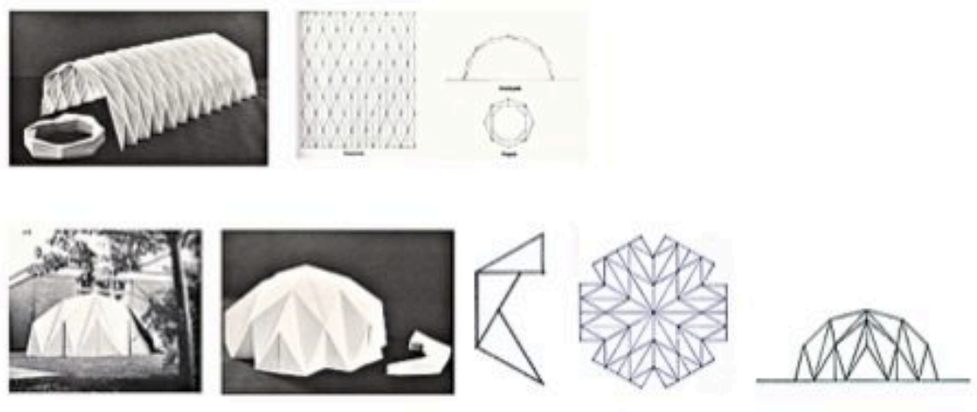
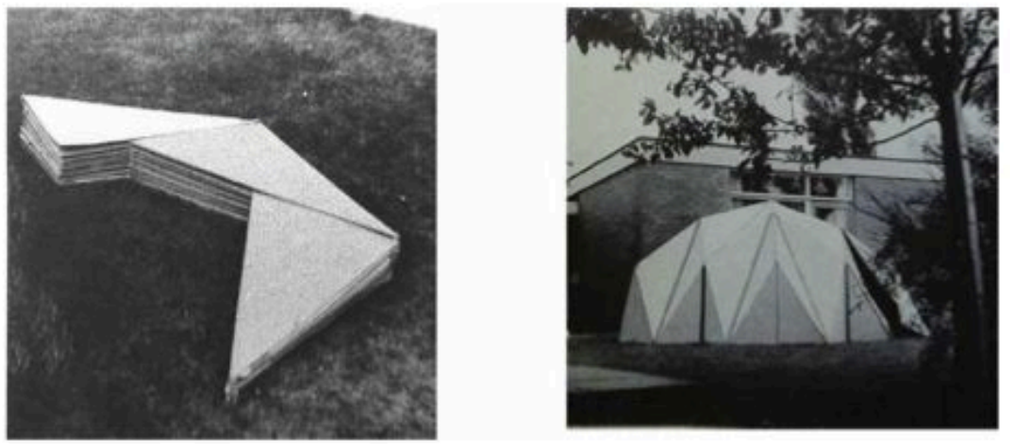
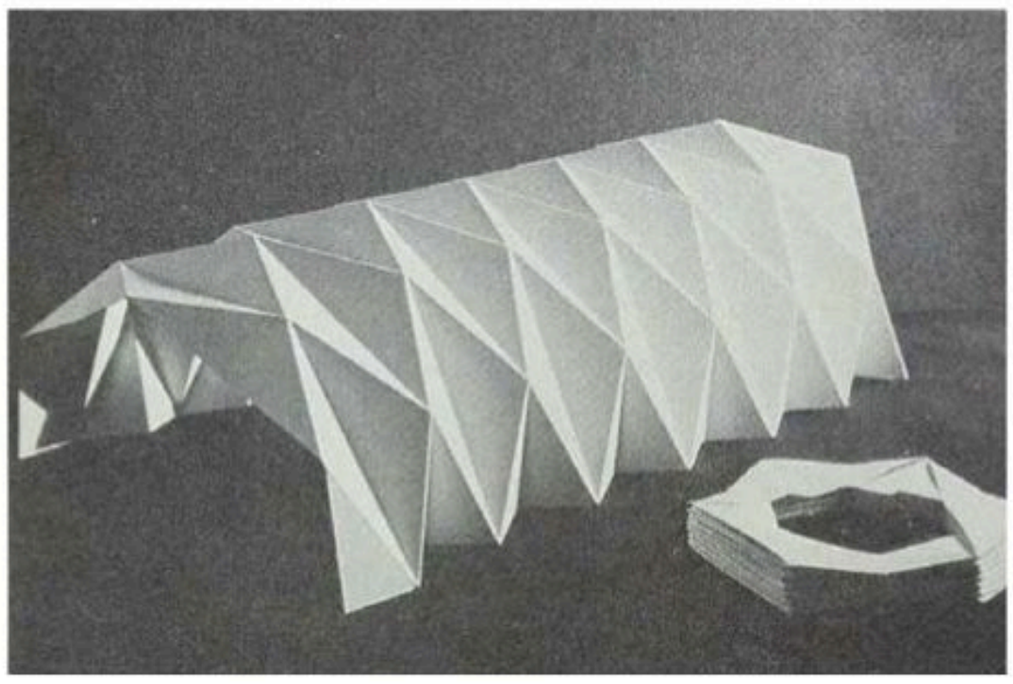
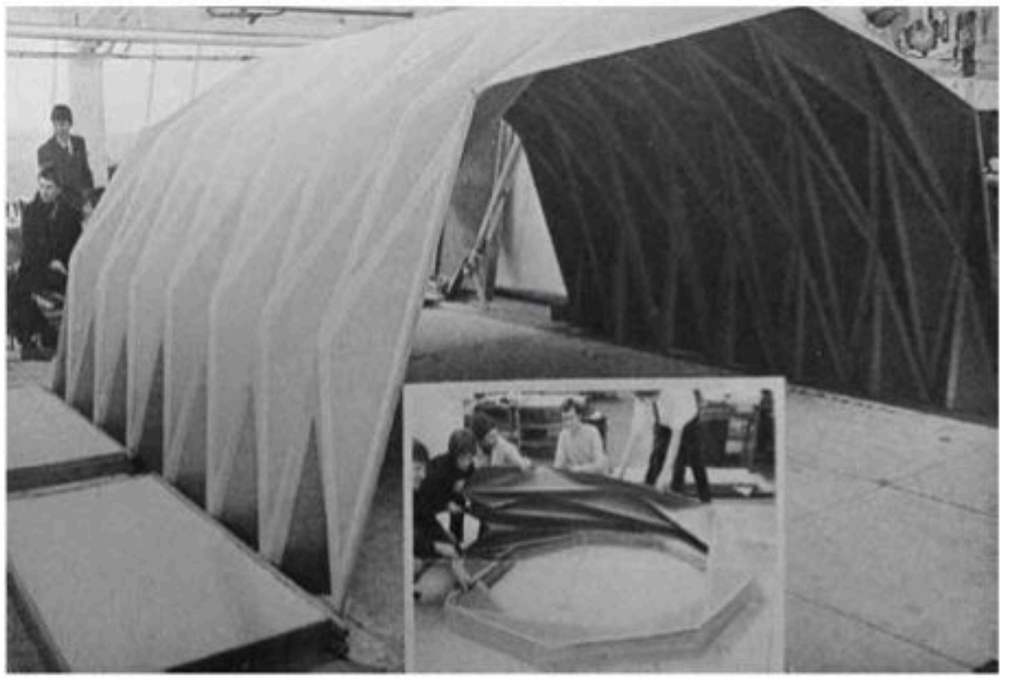


Arthur Quarmby
Folding plastic structures with collaboration of students of
Bradford Regional College of Art.
Prototypes. 1970.







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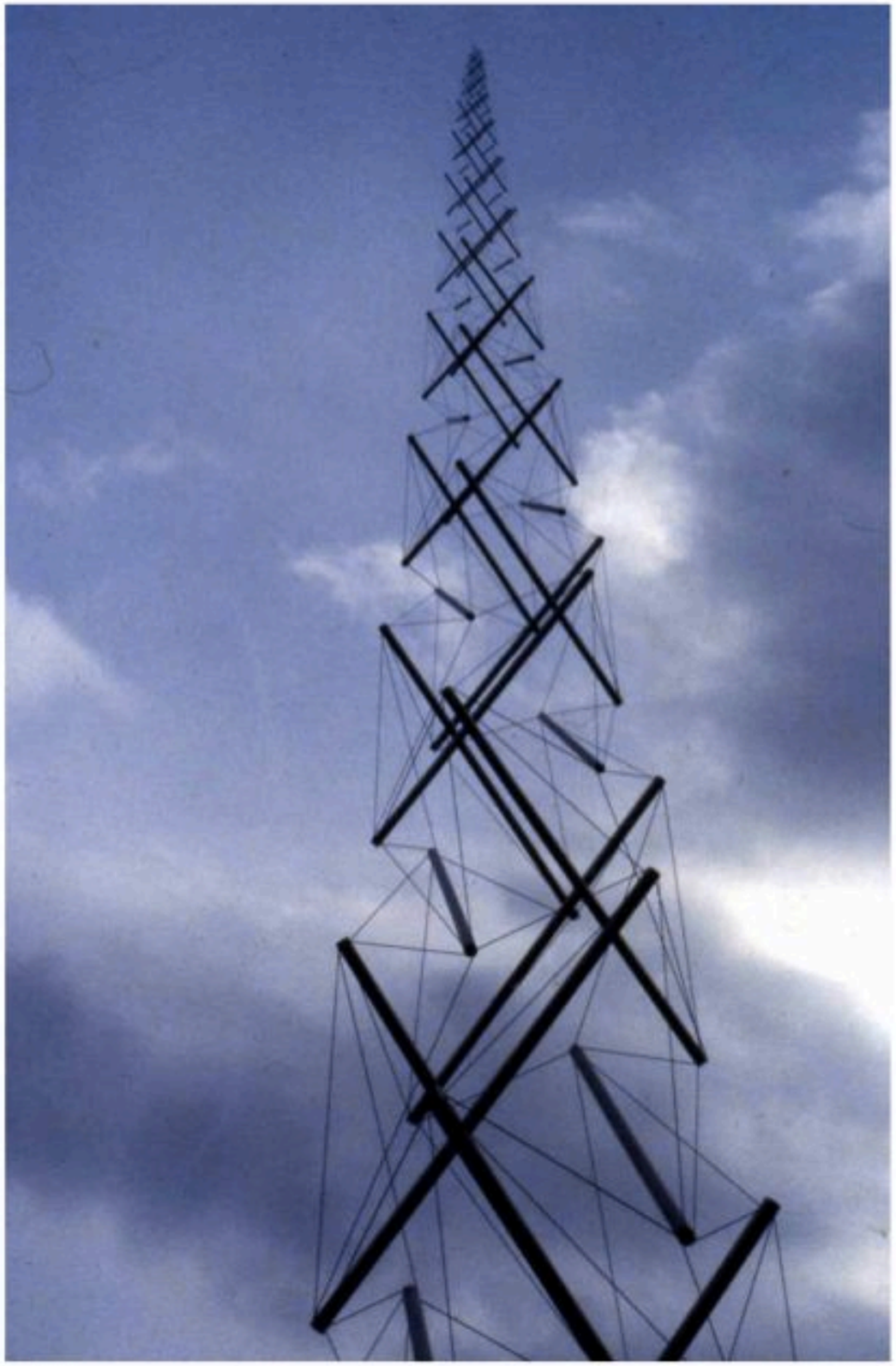
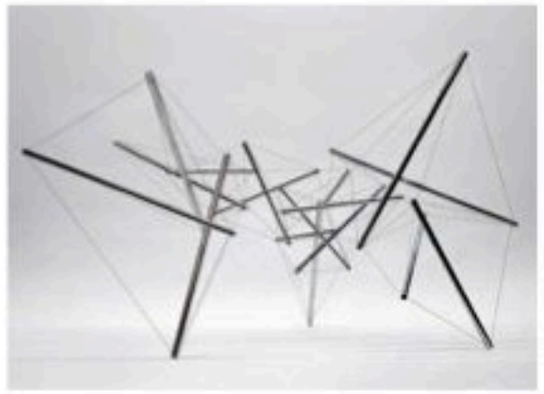




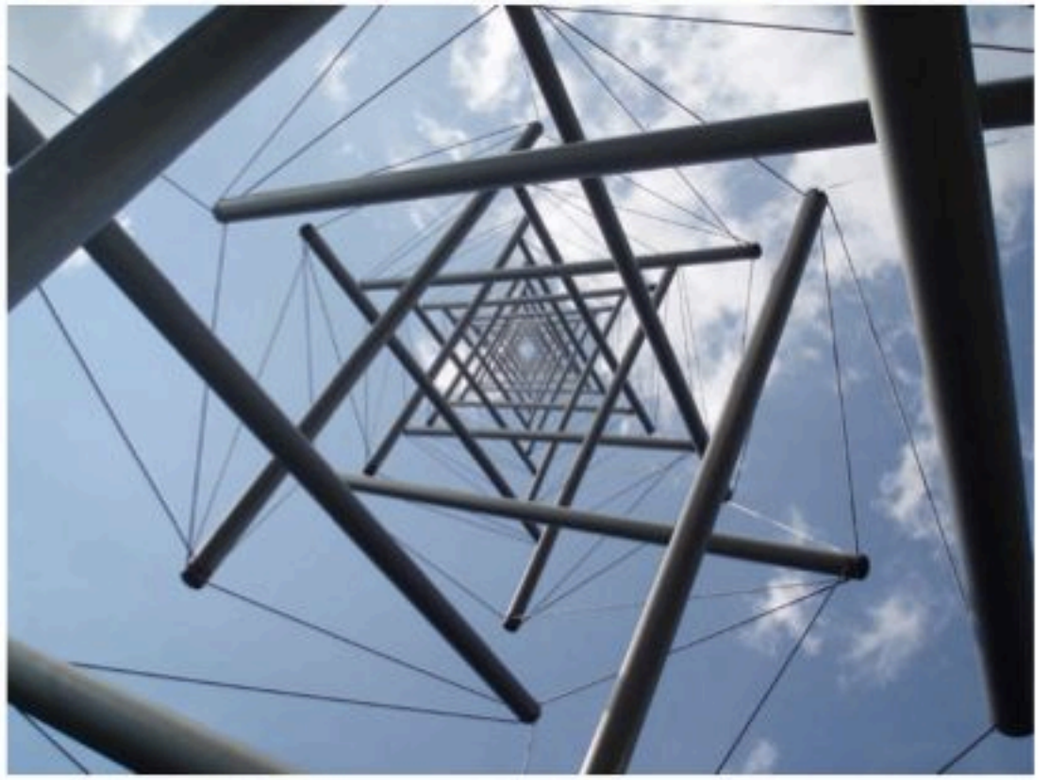
Kenneth Snelson

1. Needle Tower, 1968
aluminum & stainless steel, 18.2 x 6 x 6m
Collection: Hirshhorn Museum & Sculpture Garden, Washington, D.C.

2. Wing II, 1992
aluminum & stainless steel, 86.4 x 142.2 x 127cm

3. Needle Tower II, 1969
aluminum & stainless steel
Kröller-Müller Museum, Netherlands

1 2 3



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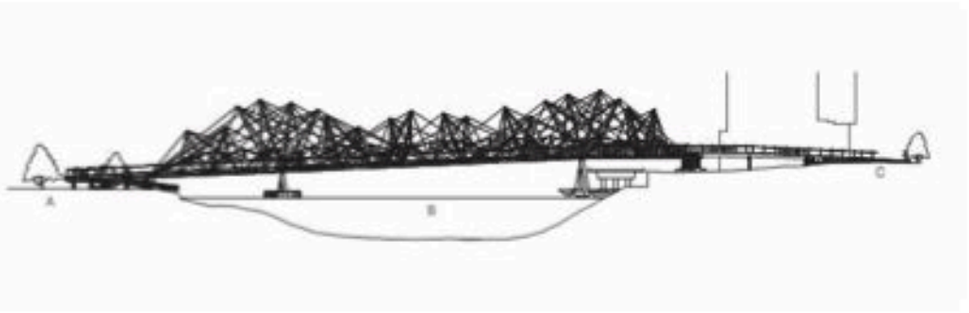


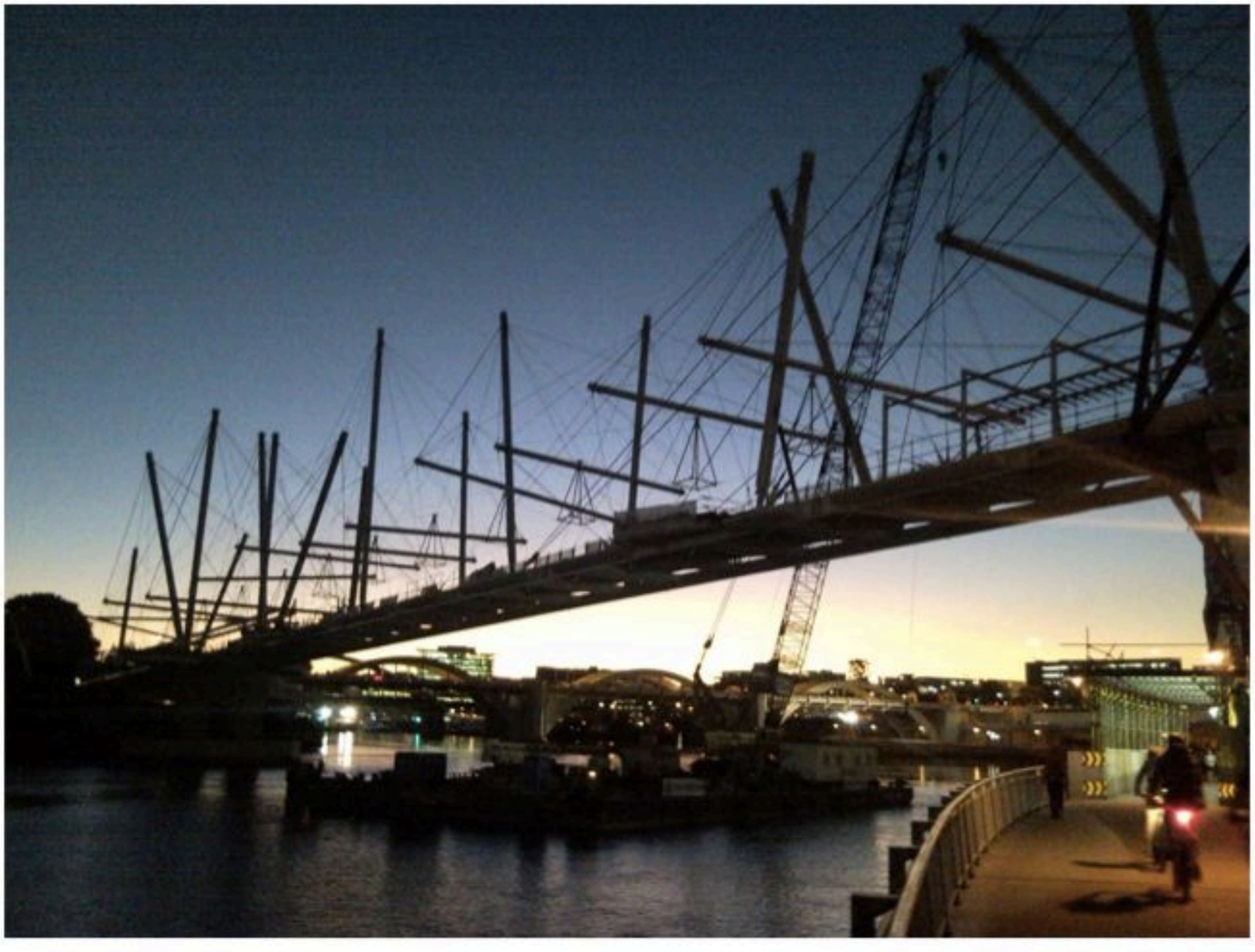
Ove Arup & Partners
Kurilpa Bridge

Passerelle piétonne et cyclable
Inaugurée le 4 octobre 2009

Acier et béton

Longueur : 425 m
Portée principale : 135 m
Largeur : 11 m

Brisbane, Australie



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