HUAS 7380-501 (87124)
Planet of the Apes: Art, Design, and the Anthropocene

Dr. Charissa N. Terranova

Fall 2017

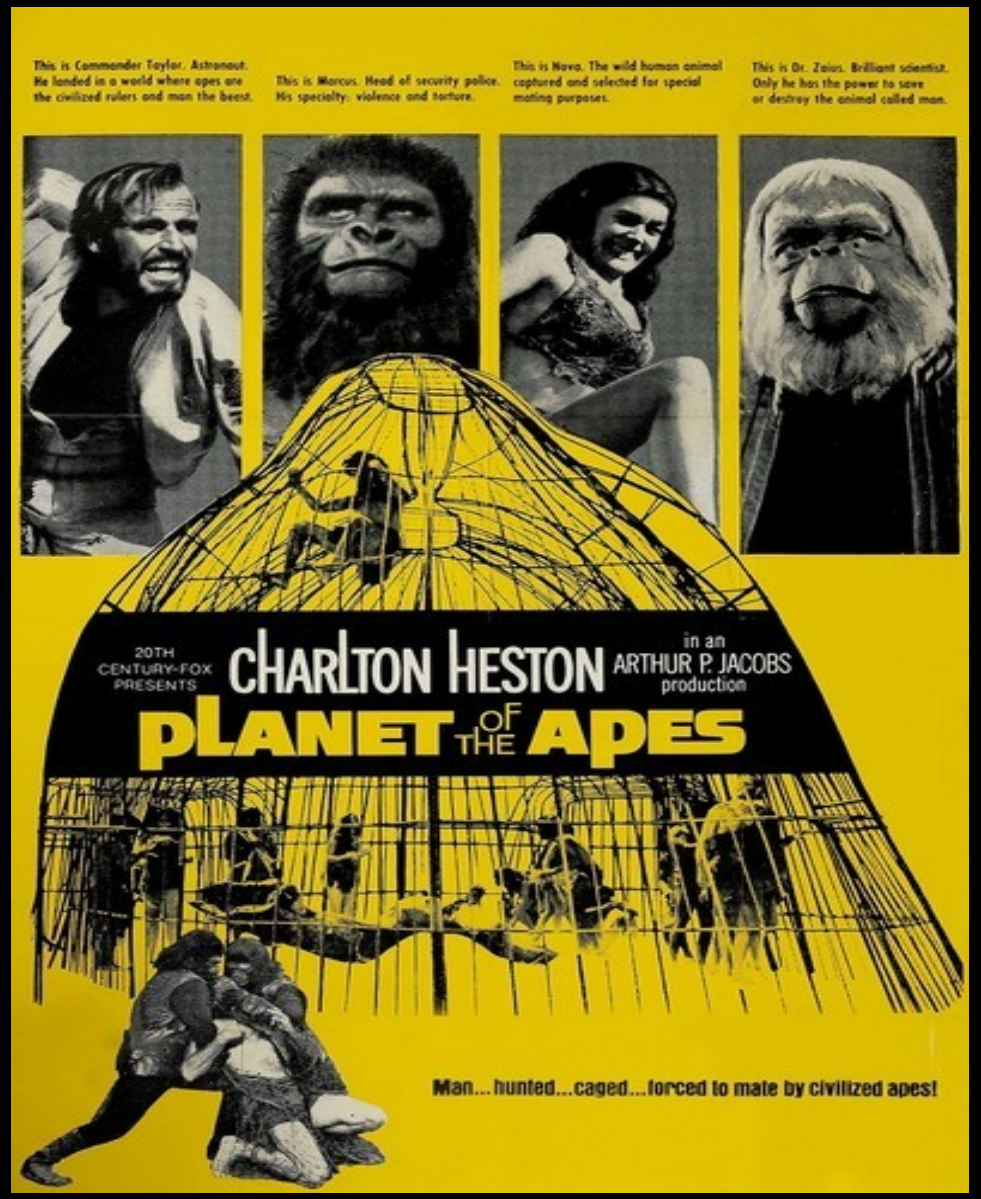
Thursday 7:00-9:45 pm

JO 4.112

09/04/17

Evolution and Co-evolution

Gene, Organism, and Environment



Richard Lewontin (b. 1929-)

- American evolutionary biologist, geneticist
- b. 1929 NYC to parents descended from late 19th-century Eastern European Jewish immigrants
- MS in Mathematical Statistics; PhD in Zoology – Columbia University
- Population genetics
- First to use computer simulation of the behavior of a single gene locus
- ”The Appointment of Human Diversity” (1972)-- In a landmark paper, Richard Lewontin (1972, p. 397) concluded that 85% of human genetic variation exists only between individuals and not between populations: “It is clear that our perception of relatively large differences between human races and subgroups, as compared to the variation within these groups, is indeed a biased perception and that, based on randomly chosen genetic differences, human races and populations are remarkably similar to each other, with the largest part by far of human variation being accounted for by the differences between individuals.”
- Persistent critic of Neo-Darwinism
- Directs criticism to sociobiology and evolutionary psychology who deploy gene-reductionism in the analysis of behavior
- Critical of EO Wilson and Richard Dawkins’ attempt to explain social behavior and social structures in terms of evolutionary advantage or strategy
- Lewontin accused neo-Darwinists of telling *Just-So Stories* when they try to show how natural selection explains such novelties as long-necked giraffes.
- A just-so story, also called an *ad hoc fallacy*, is an unverifiable narrative explanation for a cultural practice, a biological trait, or behavior of humans or other animals
- it is the basic error of lazy evolutionary reasoning. That is, if one proposes a mechanism for how something could be adaptive, one feels to have explained that thing, when it remains quite possible that two other forces are at play: 1.) *Dysfunction:* The proposed mechanism doesn't work (not an evolutionary stabile strategy), or 2.) *Contingency:* It could have been that way, but it just wasn't.
- The phrase references Rudyard Kipling’s 1902 *Just So Stories*, containing fictional and deliberately fanciful tales for children, in which the stories pretend to explain animal characteristics, such as the origin of the spots on the leopard.

Richard Lewontin, “Gene, Organism, and Environment,” *Evolution from Molecules to Men*, D. S. Bendall, ed. (Cambridge, UK: Cambridge University Press, 1983) 273–285.

Parsing ”internal” and “external” –

pg. 273:

“The modern theory of evolution is, as is so often said, a fusion of the two great insights of nineteenth century biology: Darwin’s realization that the variation between individuals within species, and Mendel’s discovery of the segregation of discrete factors as the basis for the inheritance of differences between individuals. We are constantly reminding ourselves and others that the immense progress made in biology in the present century rests firmly on these two major discoveries of a previous time. What is not always appreciated, however, is that the legacies of Darwin and Mendel are also responsible for certain difficulties in biology, difficulties that prevent us from some kinds of further progress and which keep us locked into a rigid framework of thought about development and evolution of organisms. These difficulties arise, ironically, from the very source of Mendel and Darwin’s success as biologists, their separation of internal from external forces acting on organisms.”

Ontogenetic/Phylogenetic

pg. 274:

“The essence of Darwin’s account of evolution was the separation of causes of *ontogenetic* variation, as coming from internal forces, and causes of *phylogenetic* variation, as being imposed from the external environment by way of internal selection.”

Molecular Biology versus Developmental Biology

Role of reductionism?

pg. 275:

“Some branches [of biology], such as molecular biology have made extraordinary progress by concentrating on just those questions for which the simple mechanical reductionism of the nineteenth century is the perfect epistemology. Developmental biology, the study of cognition and memory, and evolutionary biology, on the other hand, have profited only marginally from these rapid advances…”

Why does Lewontin seek to problematize the following two metaphors on page 276?

“The first, ontogenetic, process is seen as an *unfolding* of a form, already latent in the genes, requiring only an original triggering at fertilization and an environment adequate to allow ‘normal’ development to continue. The second, phylogenetic, process is seen as *problem and solution*. The environment ‘poses the problem’; the organisms posit ‘solutions,’ of which the best if finally ‘chosen’. The organism proposes; the environment disposes.”

How are we to understand linear versus non-linear thinking and/or bio-functionalism here with respect to these passages on pages 277-78?

“The fundamental general fact of **phenogenetics** is that the phenotype of organisms is a consequence of non-trivial interaction between genotype and environment during development. All that genes ever do is to specify a norm of reaction over environments. Moreover, fitness too is a phenotype and varies from environment to environment, both because other aspects of the phenotype develop differently in different environments, and a given shape or behavior or physiology will confer different fitnesses in different environments…

The little that is known shows clearly that the developmental responses of different genotypes to varying environments are non-linear and do not allow the simple ordering of genotypes along a one-dimensional scale of phenotype.”

pg. 279:

“The final step in the integration of developmental biology into evolution is to incorporate the organism as itself a *cause* of its own development, as a mediating mechanism by which external and internal factors influence its future. To describe the phenotype as the consequence of gene, environment, and accident leaves out of account entirely the element of *temporal order* which is of the essence in development process. The organism’s phenotype is in a continual state of change from fertilization to death. The phenotype at any instant is not simply the consequence of its genotype and current environment, but also of its phenotype at the previous instant.”

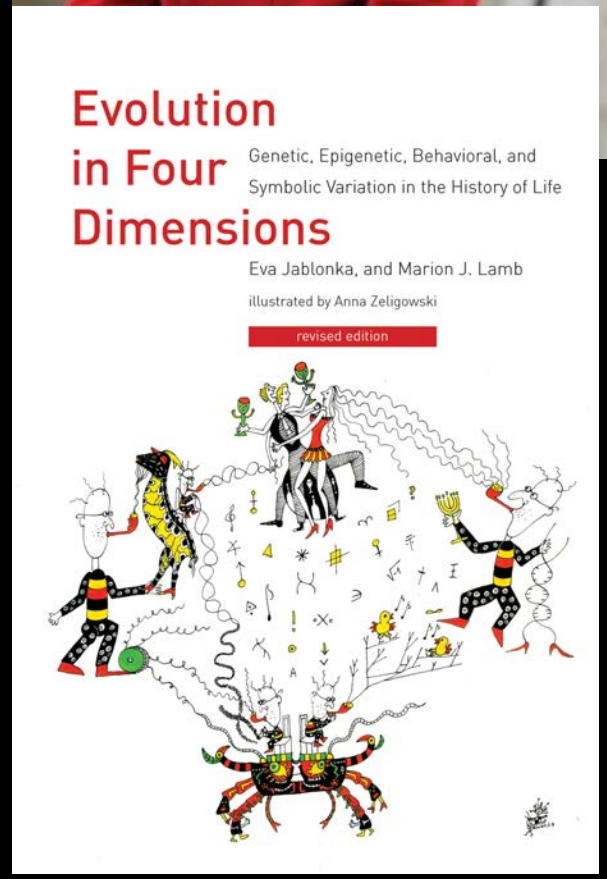
What happens to the theory of adaptation in Lewontin’s perspective?

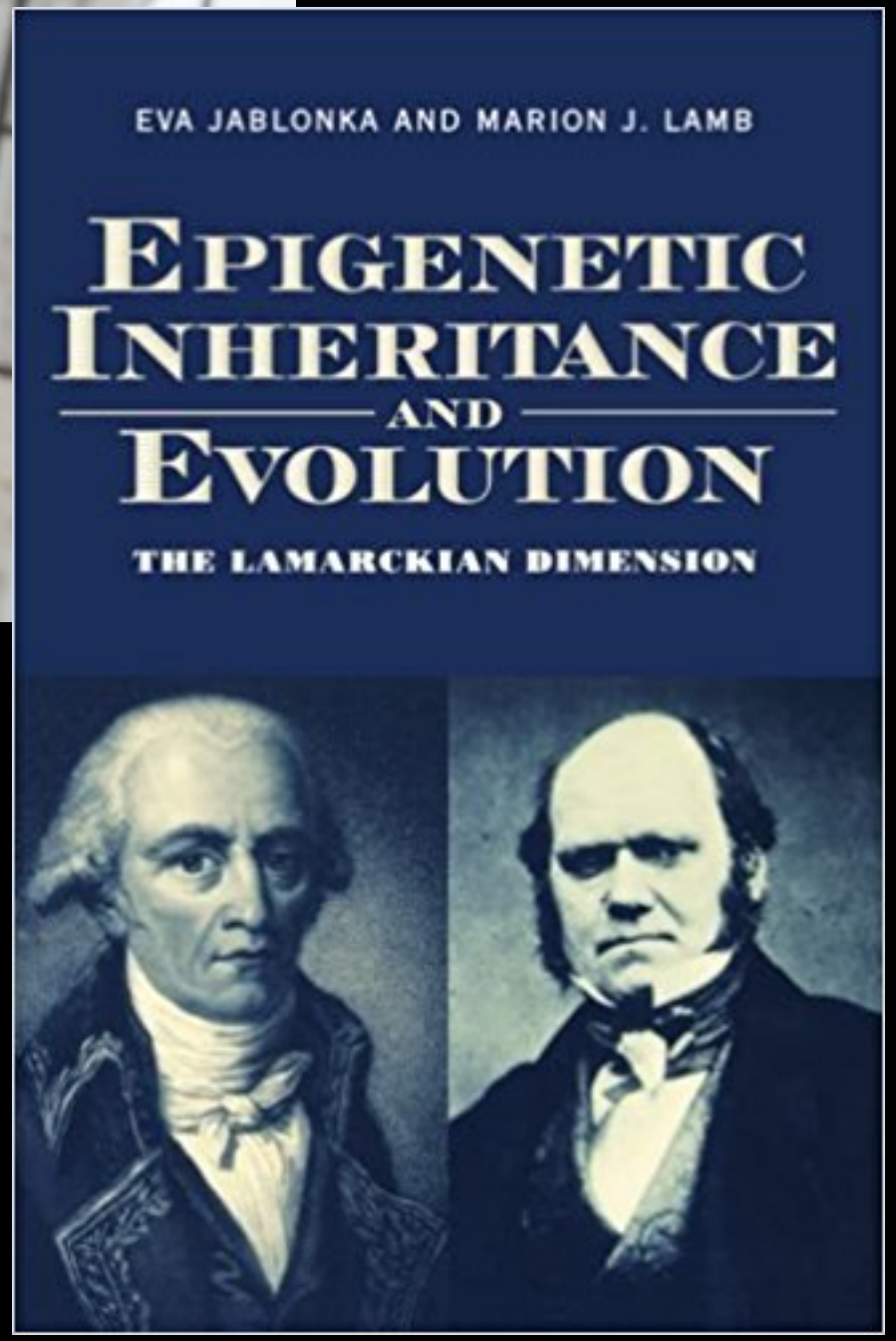
pg. 280:

“Organisms do not adapt to their environments; they construct them out of the bits and pieces of the external world.”

pg. 282:

There is a shift in metaphors from adaptation to construction.





Eva Jablonka (b. 1952-)

- Israeli theorist and geneticist
- Epigenetic inheritance
- Neo-Lamarckist views
- Professor at the Cohn Institute for the History of Philosophy of Science and Ideas at Tel Aviv University

Marion J. Lamb (b. 1923-)

- Senior Lecturer at Birkbeck, University of London, before her retirement
- studied the effect of environmental conditions such as heat, radiation and pollution on metabolic activity and genetic mutability in the fruit fly *Drosophilia*
- Worked in evolutionary developmental biology
- Evolutionary developmental biology (informally, evo-devo) is a field of biological research that compares the developmental processes of different organisms to infer the ancestral relationships between them and how developmental processes evolved.
- Evo-Devo is a combination of two disciplines within the field of biology: evolutionary biology and developmental biology. The realm of evolutionary concepts should be fairly familiar to you by now, but what is developmental biology? Developmental biology is the study of how organisms develop from a single cell through all the intermediate embryological stages, all the way to birth. Evolutionary developmental biology, then, or Evo-Devo for short, is a way to look at the way that the mechanisms of development have been influenced by evolutionary forces.

Eva Jablonka and Marion J. Lamb, “Précis of *Evolution in Four Dimensions*,” *Behavioral and Brain Sciences,* No. 30 (2007) 353-392.

What are Jablonka and Lamb’s four dimensions of evolution?

- Genetic
- Epigenetic
- Behavioral
- Symbolic

General Questions

- Who is August Weismann and why is he important to their argument? (pg. 354)
- What is the Modern Synthesis (review from last week/pg. 355)
- What is problematic about the Central Dogma [DNA-RNA-Protein]? (pg. 356)
- How does this sentence implicate “complexity”? “What the new knowledge about the relation between DNA and characters shows is that thinking about the development of traits and trait variations in terms of single genes and single-gene variations is inappropriate.” (pg. 357)
- How do we understand “epigenetic inheritance”? (pp. 357-358)
- How do we understand “socially mediated learning”? (359-360)
- How do we understand “symbolic information transmission”? (pp. 360-361)
- What does a unified theory of evolution – in all of its dimensions – promise? (pp. 362-365)

Epigenesis, Epigenetics, and Autopoesis

In biology, and specifically genetics, **epigenetics** is the study of heritable changes in gene activity that are *not* caused by changes in the DNA sequence.

“Once nurture seemed clearly distinct from nature. Now it appears that our diets and lifestyles can change the expression of our genes. How? By influencing a network of chemical switches within our cells collectively known as the epigenome. This new understanding may lead us to potent new medical therapies. Epigenetic cancer therapy, for one, already seems to be yielding promising results.”

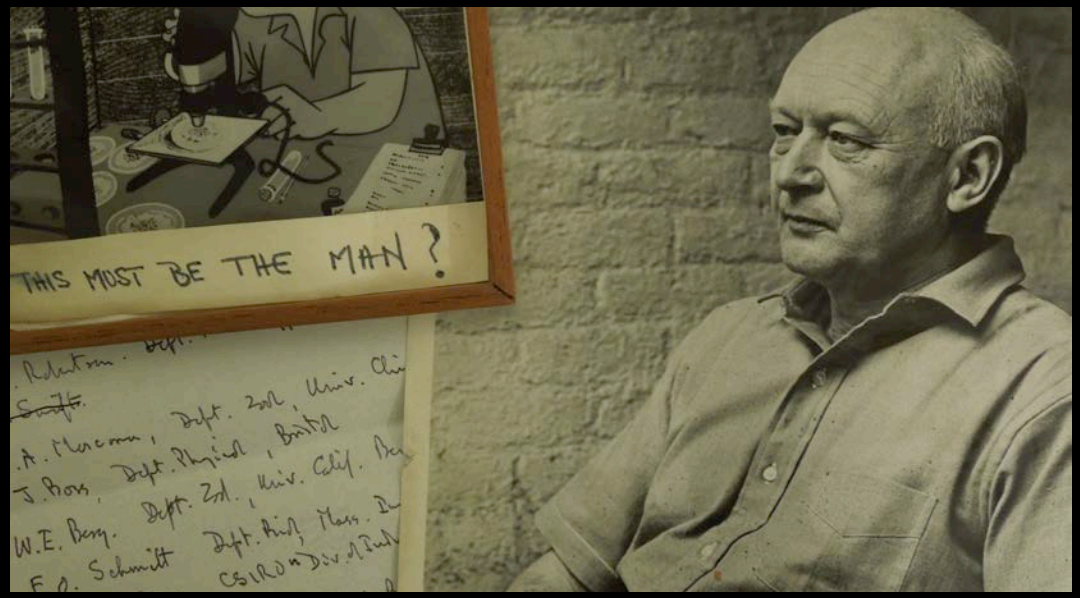
Epigenetics, Posted 07.24.07, NOVA scienceNOW, http://www.pbs.org/wgbh/nova/body/epigenetics.html

Autopoeisis - "**Autopoiesis**" (from Greek *auto-*, meaning "self", and *poiesis*, meaning "creation, production") refers to a system capable of reproducing and maintaining itself.

“An autopoietic machine is a machine organized (defined as a unity) as a network of processes of production (transformation and destruction) of components which: (i) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them; and (ii) constitute it (the machine) as a concrete unity in space in which they (the components) exist by specifying the topological domain of its realization as such a network.”

Autopoiesis and Cognition: the Realization of the Living, Humberto Maturana and Francisco Varela

Who was Conrad Waddington?



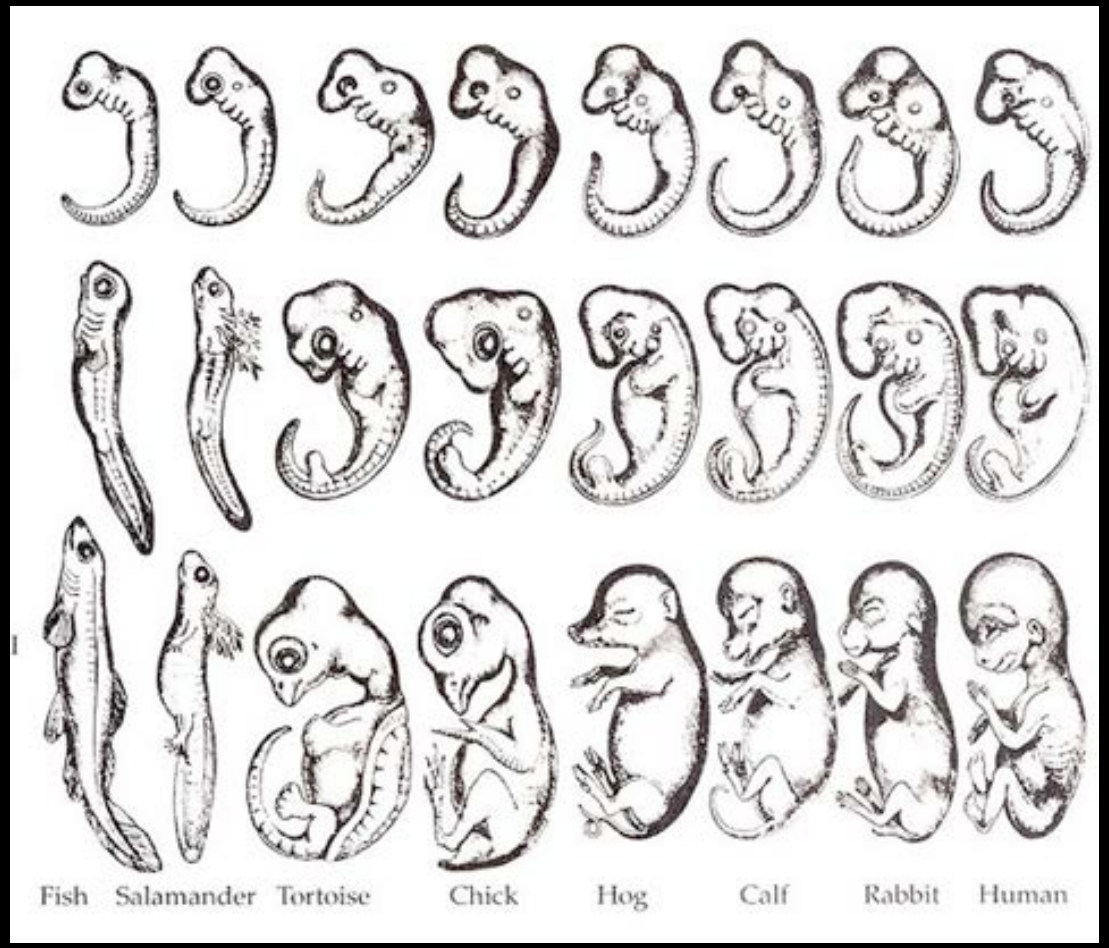
- [1905-1976]
- British developmental biologist and geneticist
- Systems Biology

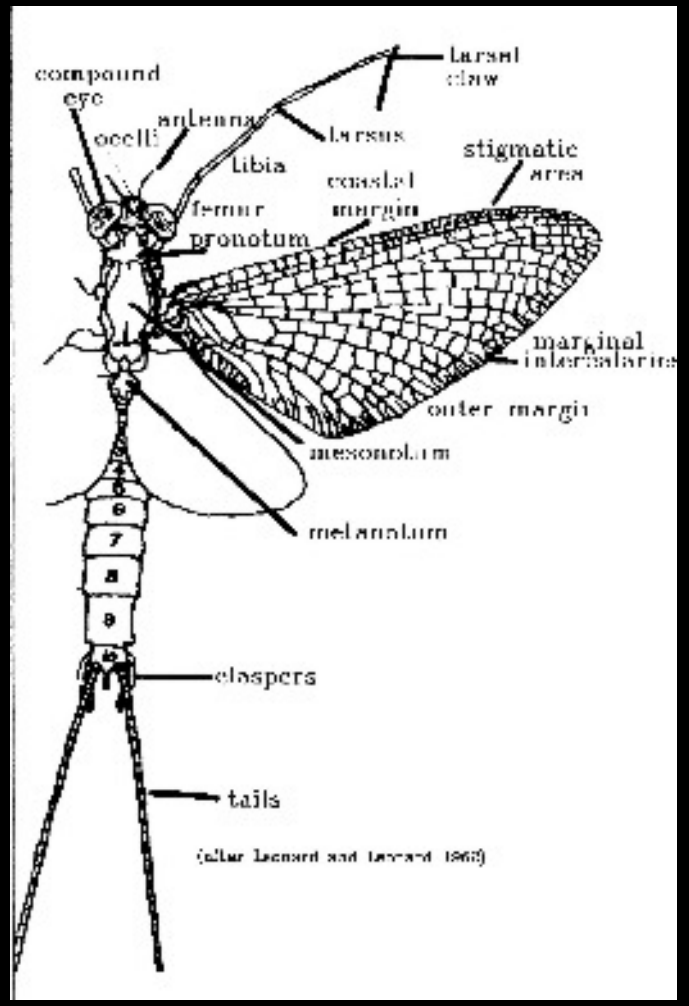
  - a field of study, particularly, the study of the interactions between the components of *biological systems*, and how these interactions give rise to the function and behavior of that system (for example, the enzymes and metabolites in a metabolic pathway).

  - a paradigm, usually defined in antithesis to the so-called reductionist paradigm (biological organisation), although fully consistent with the scientific method. Indeed, the focus on the dynamics of the studied systems is the main conceptual difference between systems biology and bioinformatics.

  - a biology-based inter-disciplinary field of study that focuses on complex interactions within biological systems, using a more holistic perspective (holism instead of the more traditional reductionism) approach to biological and biomedical research.

- Interested in poetry and painting, as well as left-wing political leanings.
- In his book *The Scientific Attitude* (1941), he touched on political topics such as central planning and praised Marxism as a "profound scientific philosophy".



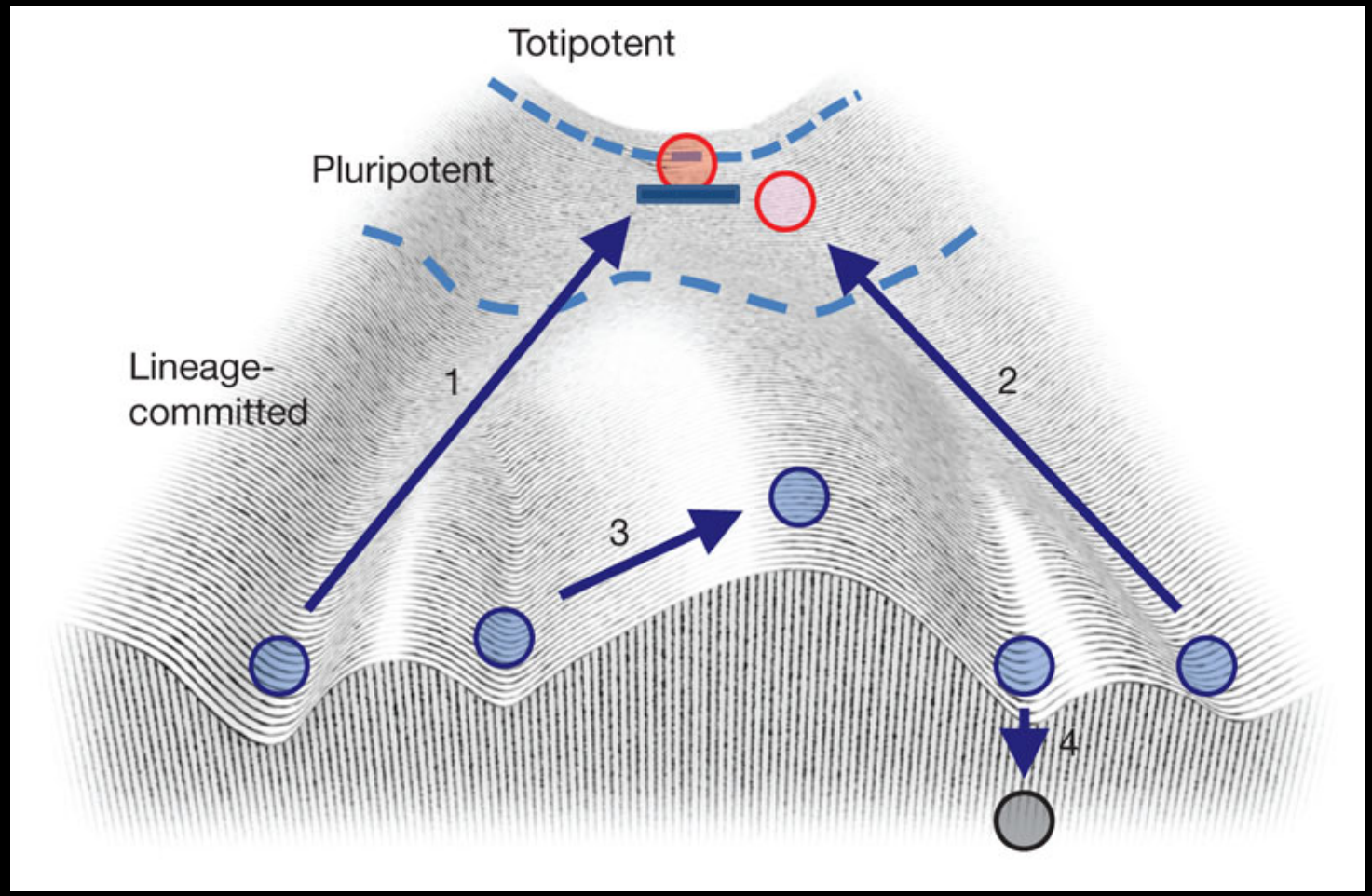


- evolutionary biology

- genetic assimilation - similar to the Lamarkian notion of evolution -- that organisms can 'force' their own evolution. It is a process whereby some environmental condition (usually an environmental stressor) causes an alteration in an organism's phenotype which that organism is then able to express in successive generations without the existence of the environmental stimuli.

- Conrad Waddington, the proposer of this notion, exposed fly pupae to excessive heat. Some of the adults in this laboratory population then displayed an unusual gap in the crossveins of their wings.

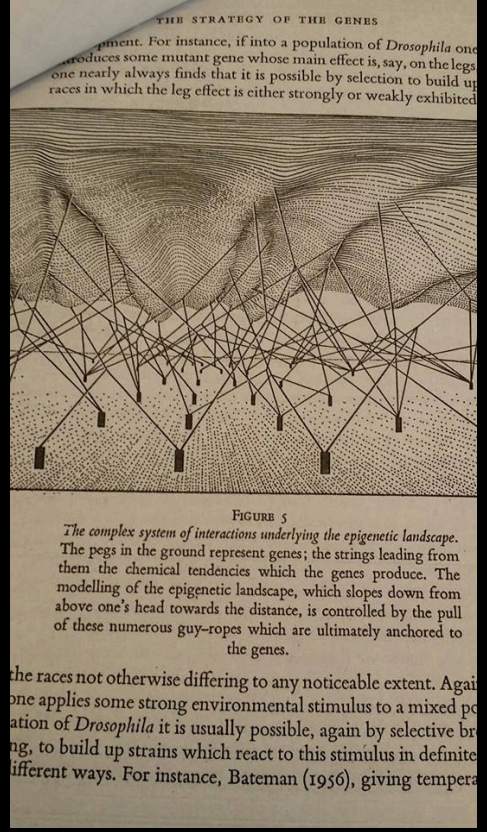
http://tomorrowstheme.blogspot.com/2011_07_01_archive.html



CREODE – “necessary path”

Creode is a neologism coined by the biologist C.H. Waddington to represent the developmental pathway followed by a cell as it grows to form part of a specialized organ. Combining the Greek roots for "necessary" and "path," the term was inspired by the property of regulation.[1] When development is disturbed by external forces, the embryo attempts to regulate its growth and differentiation by returning to its normal developmental trajectory.

Waddington explains development with the metaphor of a ball rolling down a hillside, where the hill's contours channel the ball in a particular direction. In the case of a pathway or creode which is deeply carved in the hillside, external disturbance is unlikely to prevent normal development. He notes that creodes tend to have steeper sides earlier in development, when external disturbance rarely suffices to alter the developmental trajectory.



THE STRATEGY OF THE GENES

pment. For instance, if into a population of *Drosophila* one
roduces some mutant gene whose main effect is, say, on the legs
one nearly always finds that it is possible by selection to build up
races in which the leg effect is either strongly or weakly exhibited

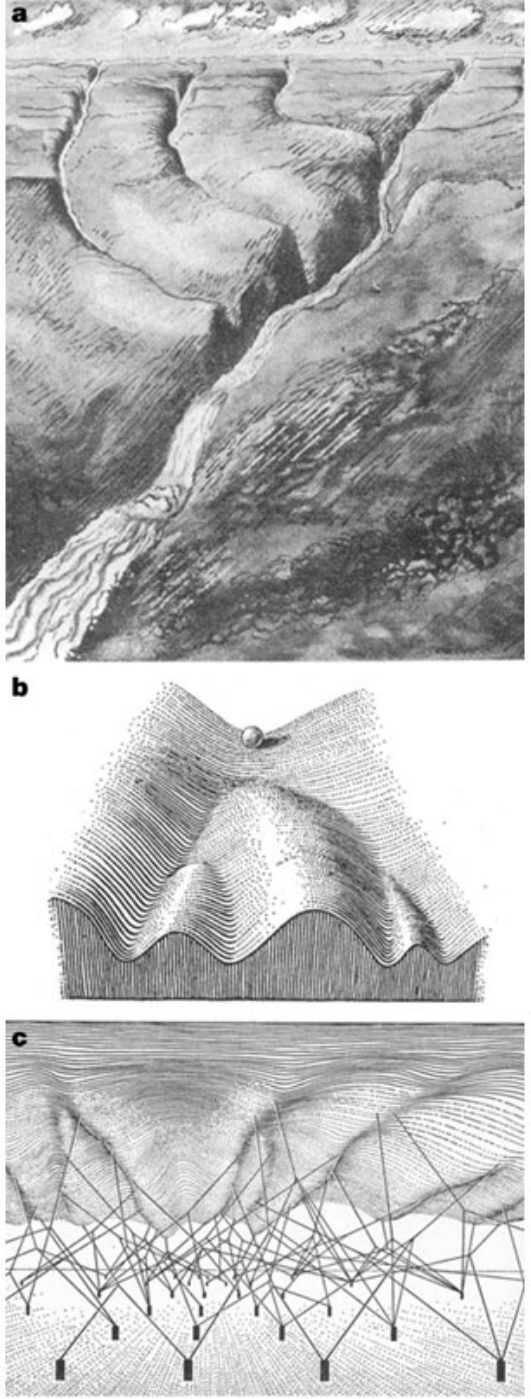
FIGURE 5

The complex system of interactions underlying the epigenetic landscape. The pegs in the ground represent genes; the strings leading from them the chemical tendencies which the genes produce. The modelling of the epigenetic landscape, which slopes down from above one's head towards the distance, is controlled by the pull of these numerous guy-ropes which are ultimately anchored to the genes.

he races not otherwise differing to any noticeable extent. Agai
one applies some strong environmental stimulus to a mixed po
ation of *Drosophila* it is usually possible, again by selective br
ng, to build up strains which react to this stimulus in definite
ifferent ways. For instance, Bateman (1956), giving tempera

EPIGENETIC LANDSCAPE

Waddington refers to the network of creodes carved into the hillside as an "epigenetic landscape," meaning the formation of the body depends on not only its genetic makeup but the different ways genes are expressed in different regions of the embryo. He expands his metaphor by describing the underside of the epigenetic landscape. Here we see that the "landscape" is really more like a giant sheet that would blow away except that a series of tension-bearing cables holds it down. The pegs that connect the cables to the ground are the genes. The cables themselves are the epigenetic factors that influence gene expression in various regions of the embryo. The depth and direction of the channels is thus determined by a combination of genetic makeup and the epigenetic feedback loops by which genes are regulated.



Nature Reviews | Genetics

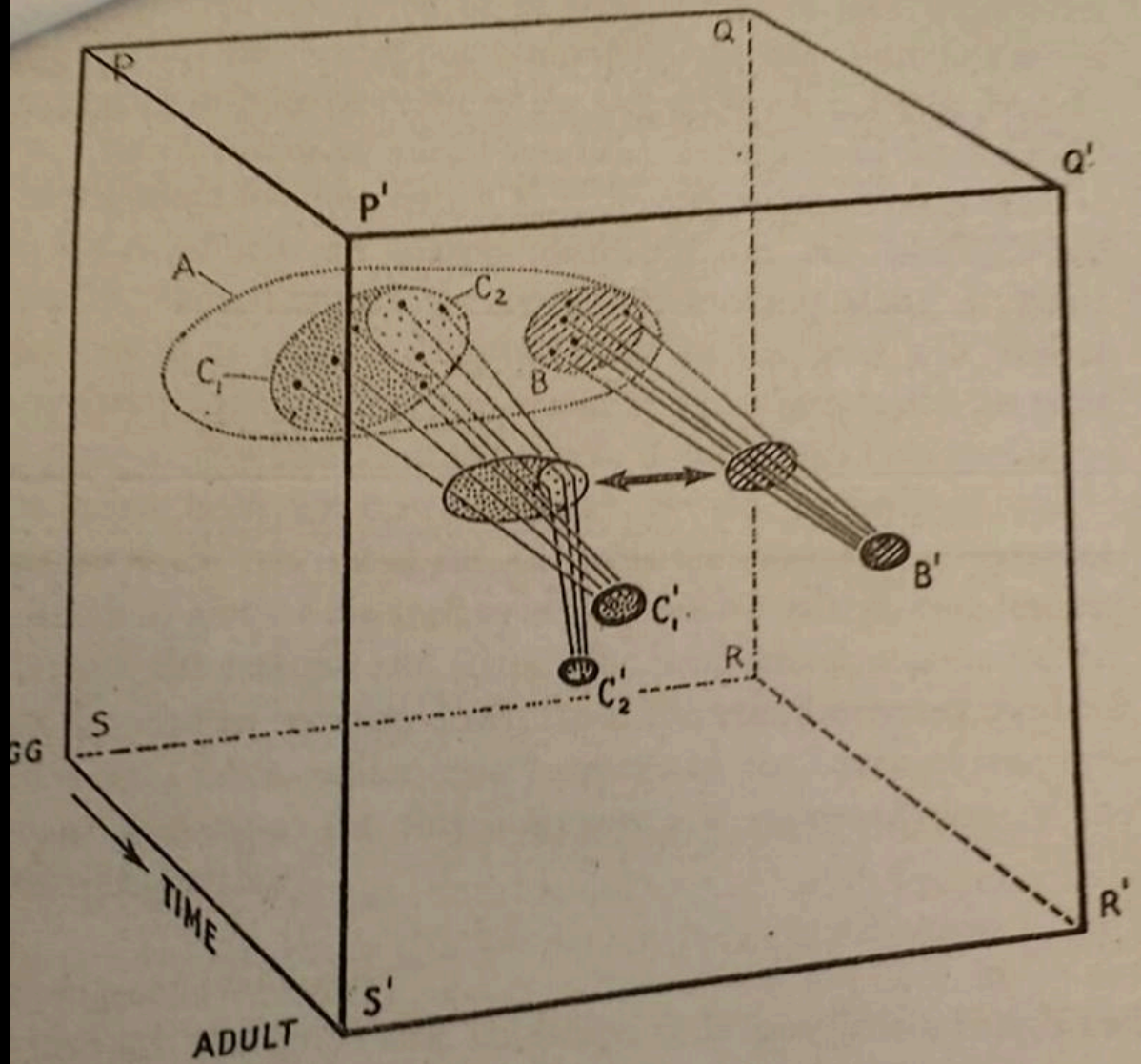


FIGURE 3

A phase–space diagram of development. The time axis runs perpendicular to the paper, from the plane *PQRS* at the time of fertilisation

extent. Consider a more or less flat, or rather undulating, e, which is tilted so that points representing later states are than those representing earlier ones (Fig. 4). Then if some-

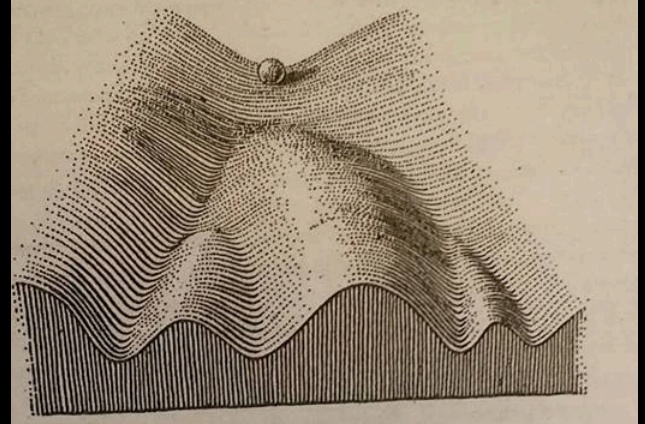


FIGURE 4

Part of an Epigenetic Landscape. The path followed by the ball, as it rolls down towards the spectator, corresponds to the developmental history of a particular part of the egg. There is first an alternative, towards the right or the left. Along the former path, a second alternative is offered; along the path to the left, the main channel continues leftwards, but there is an alternative path which, however, can only be reached over a threshold.

PHASE SPACE
EPIGENETIC LANDSCAPE

Phase space is a multidimensional space of genetic development. Here all possible states of a system are represented, with each possible state of the system corresponding to one unique point in the phase space.

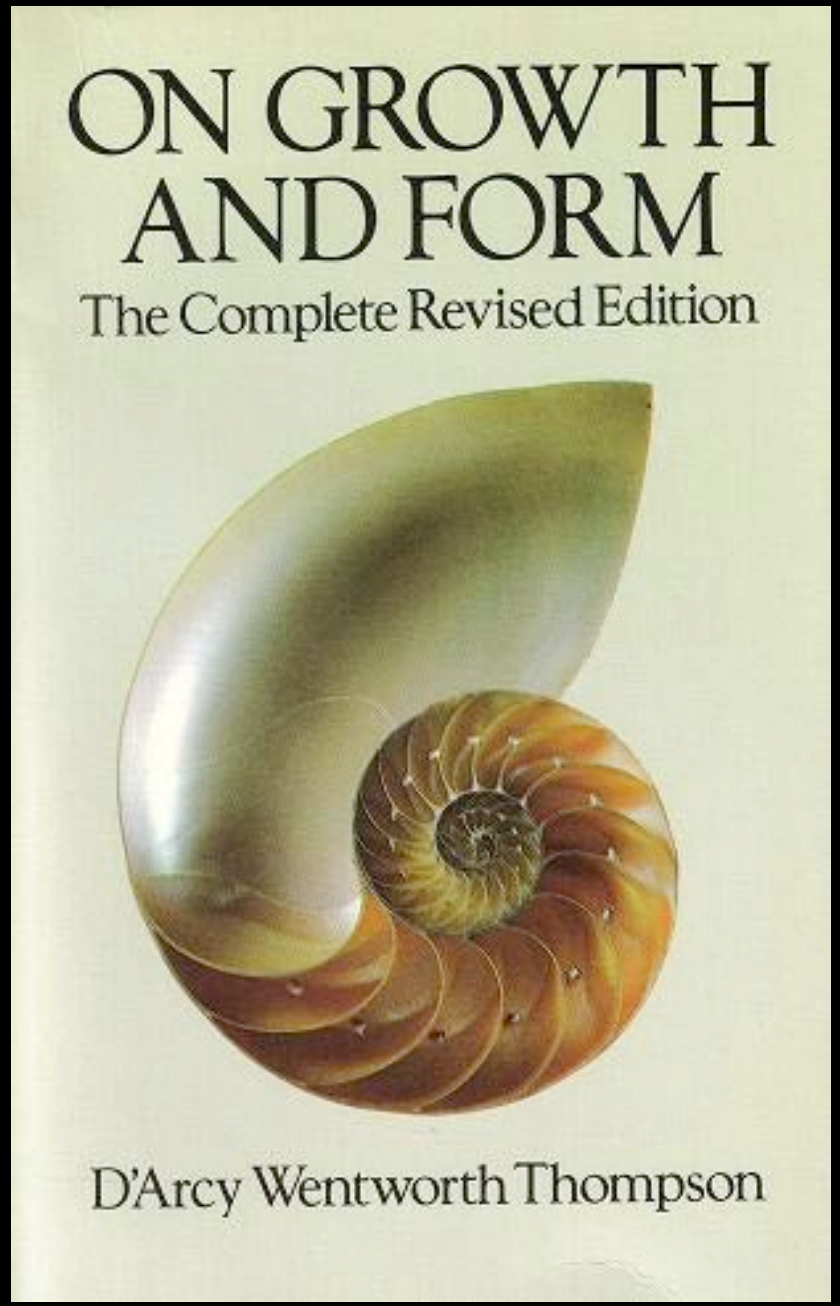
homeostasis/homeorhesis

- homeostasis - is the property of a system in which variables are regulated so that internal conditions remain stable and relatively constant.
  - A **homeostasis** operates by switching heaters or air-conditioners on and off in response to the output of a temperature sensor.
  - Cruise control adjusts a car's throttle in response to changes in speed.

- homeorhesis - a concept encompassing dynamical systems which return to a trajectory, as opposed to systems which return to a particular state, which is termed homeostasis.
- "Whereas the process of keeping something at a stable, or stationary value is called homeostasis, ensuring the continuation of a given type of change it is called homeorhesis." C.H. Waddington
- The word itself is a little-used term of art in biology, where it describes the tendency of developing or changing organisms to continue development or change towards a given state, even if disturbed in development. The term was first coined by C.H. Waddington, on or before 1940, along with the related term chreod, meaning "necessary path", which is the trajectory to which the system tends to return.
- [GAIA HYPOTHESIS]
- In ecology the concept is important as an element of the Gaia hypothesis, where the system under consideration is the ecological balance of different forms of life on the planet. It was Lynn Margulis, the coauthor of Gaia hypothesis, who wrote in particular that only homeorhetic and not homeostatic balances are involved in the theory. That is, the composition of Earth's atmosphere, hydrosphere, and lithosphere are regulated around "set points" as in homeostasis, but those set points change with time

05-11-2012
Yasuaki Onish
Reverse of Volume RG

Writer Sanford Kwinter famously appropriated Conrad Waddington's "Epigenetic Landscape" as a topological model with which to envision a new conception of formmaking, whereby matter is intrinsically latent with tendencies that "condition" its morphological evolution. Anticipating the formal free-for-all that would follow in the first decade of the new millennium, Kwinter warned against using the "form" of the epigenetic landscape (as drawn by Waddington or any other iteration) for analogical purposes, but I'm about to do just that. For his "Reverse of Volume RG" installation, Japanese artist Yasuaki Onishi has suspended a mold of "nothing", in reality, a plastic sheet held in place by strands of black hot glue string from the ceiling of the Rice Gallery in Houston. Whereas Onishi describes the piece as "casting the invisible", the resultant form approximates the billowing and folding field of Waddington's model.

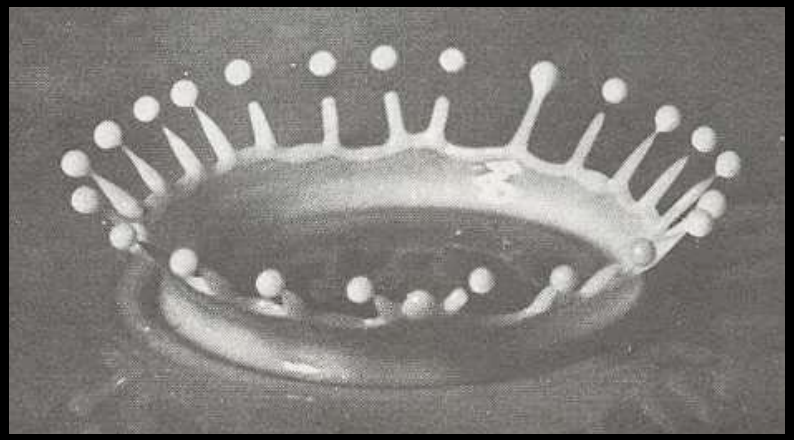


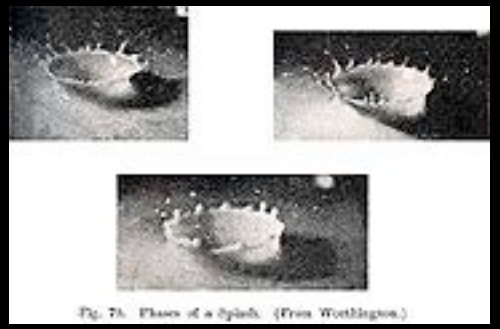
D'Arcy Wentworth Thompson (1860-1948)

- Scottish biologist, mathematician
- Pioneer of mathematical biology
- Allometry: the study of the relationship of body size to shape, anatomy, physiology, and finally behavior
- Thompson on allometry:

"An organism is so complex a thing, and growth so complex a phenomenon, that for growth to be so uniform and constant in all the parts as to keep the whole shape unchanged would indeed be an unlikely and an unusual circumstance. Rates vary, proportions change, and the whole configuration alters accordingly."

- correlations between biological forms and mechanical phenomena
- Pure mathematics
- Force
- Topology





In *Growth and Form*, Thompson proposed that biologists had over-emphasized evolution (and especially natural selection) and under-emphasized the constraints and parameters within which organisms develop, constraints that "channel" animal forms into particular patterns that are repeated over and over again across the phyla. His argument is essentially that biological form is constrained by the kind of mathematical relationships that characterize classical physics. That is, there are "built-in" laws of form that constrain the forms that biological organisms can take. And therefore, physical law provides the “front-loading”, not a supernatural “intelligent designer.”

For example, Thompson pointed out that the shape that droplets of viscous liquid take when dropped into water are virtually identical to the medusa forms of jellyfish, and that this "convergence of form" is therefore not accidental. Rather, it is fundamentally constrained by the physics of moving fluids, as described in the equations of fluid mechanics.

http://evolutionlist.blogspot.com/2006/07/darcy-thompson-and-front-loaded.html

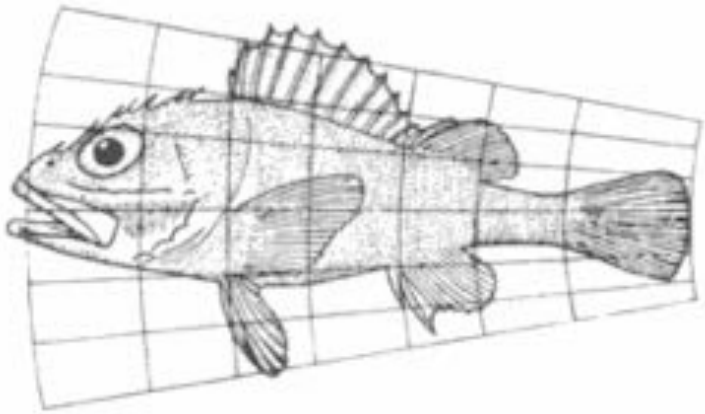


Fig. 152. *Scorpaena* sp.

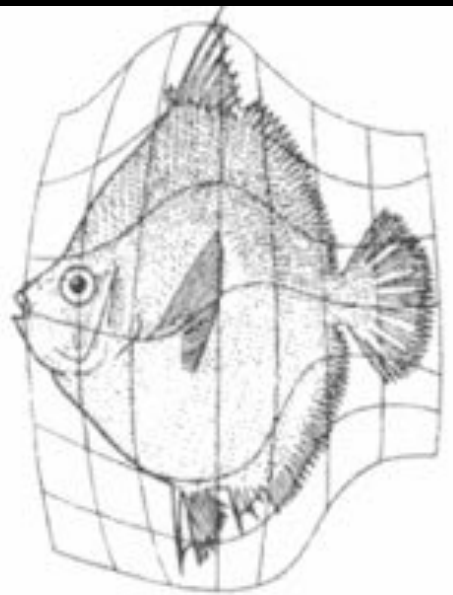
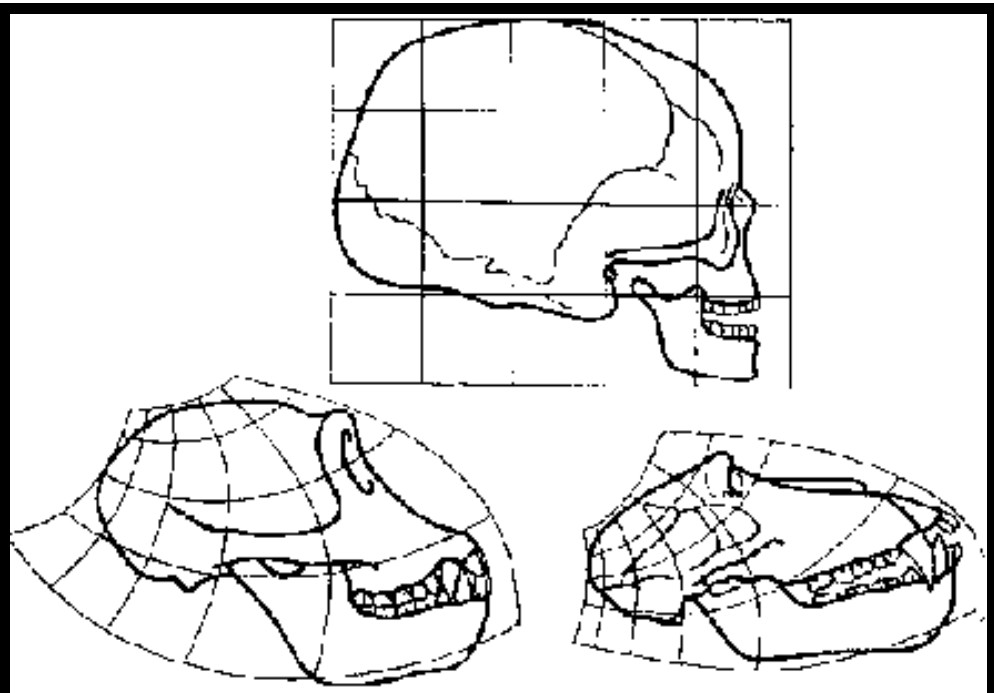
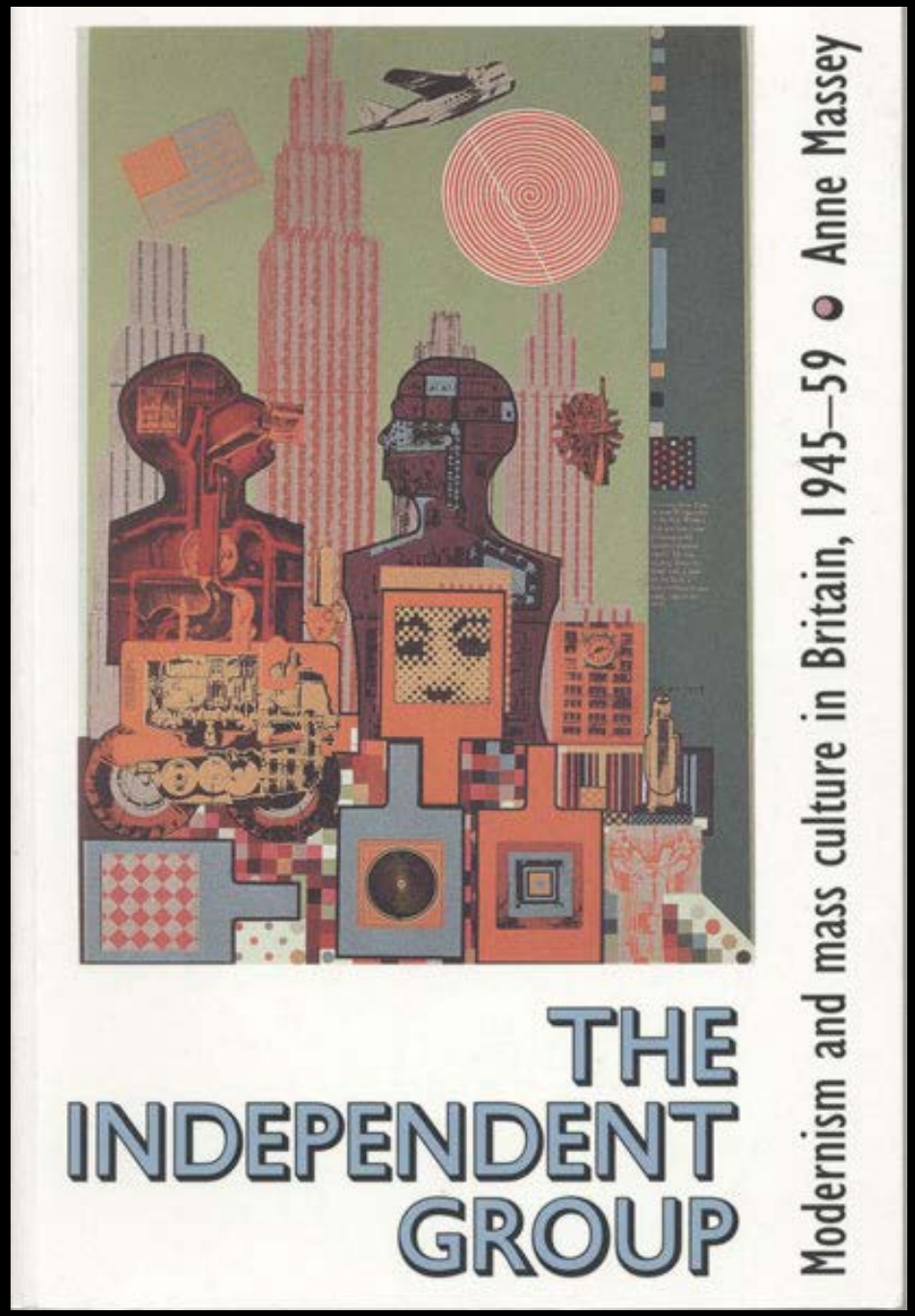


Fig. 153. *Antigonia capros*.

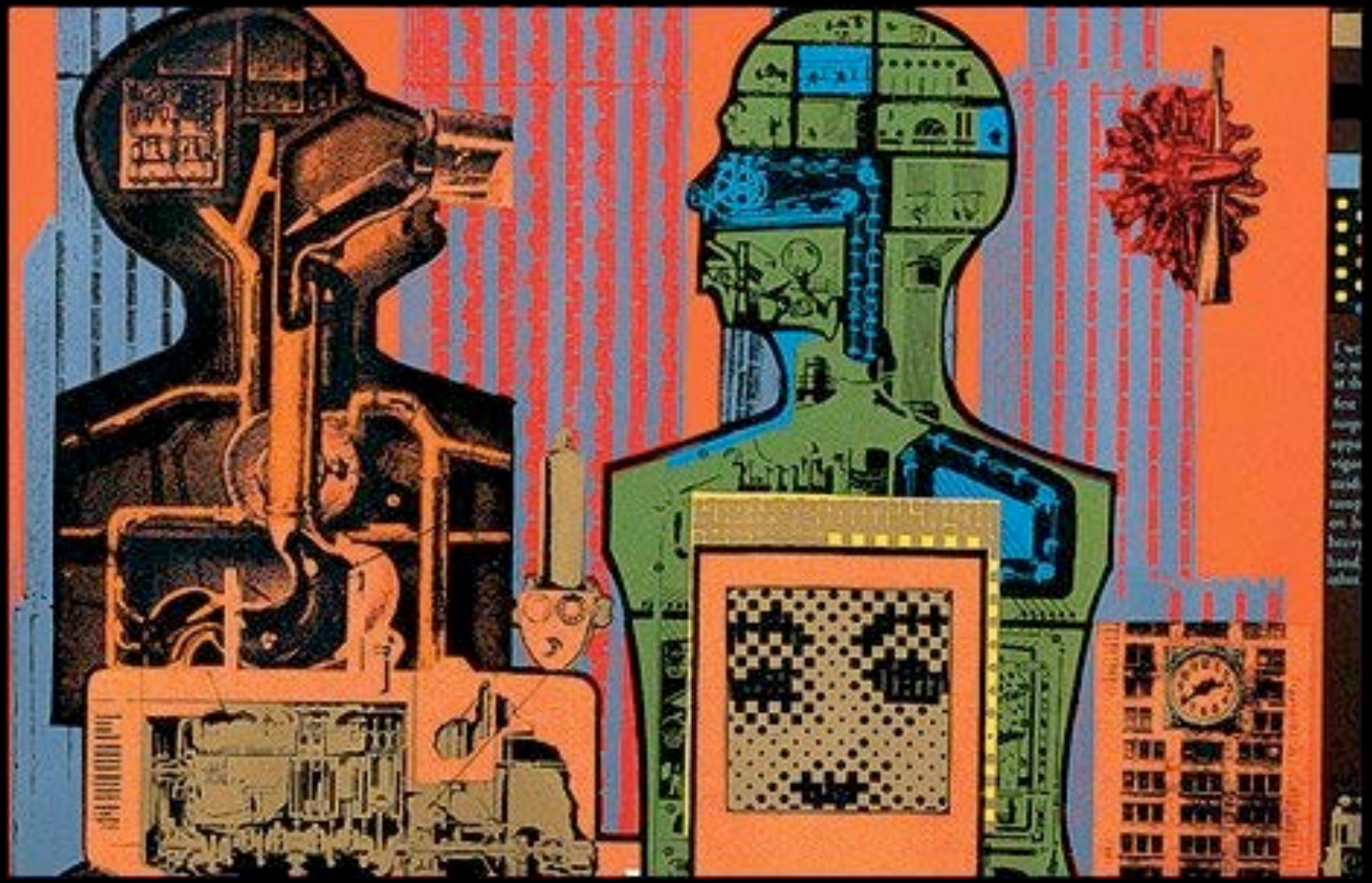


Skulls of a human, a chimpanzee and a baboon
and transformations between them



Book cover from *The Independent Group's Modernism and Mass culture in Britain 1945-59* exhibition

Eduardo Paolozzi "Wittgenstein in New York,"1964



Modern Sources:

Consumerism

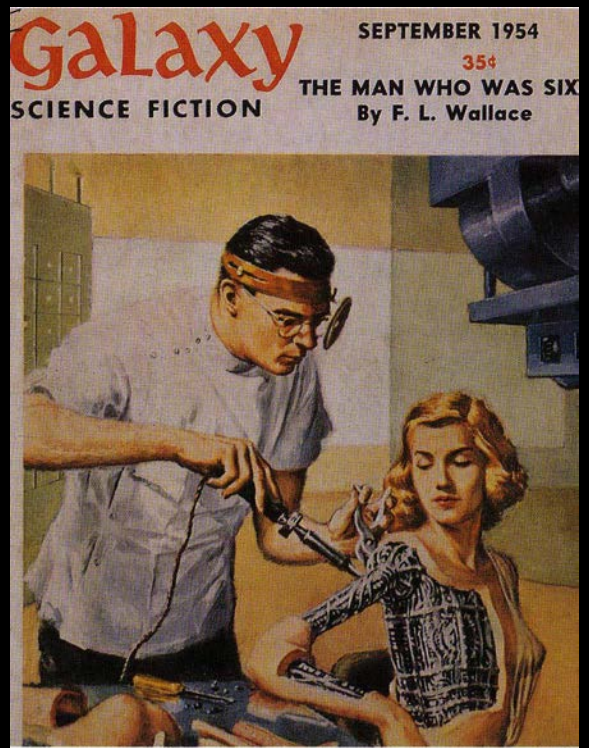
Science Fiction

Richard Hamilton, $he, 1958-61; oil and collage on panel

Right Above: Wall Panel with Robie the Robot from

This is Tomorrow Exhibition

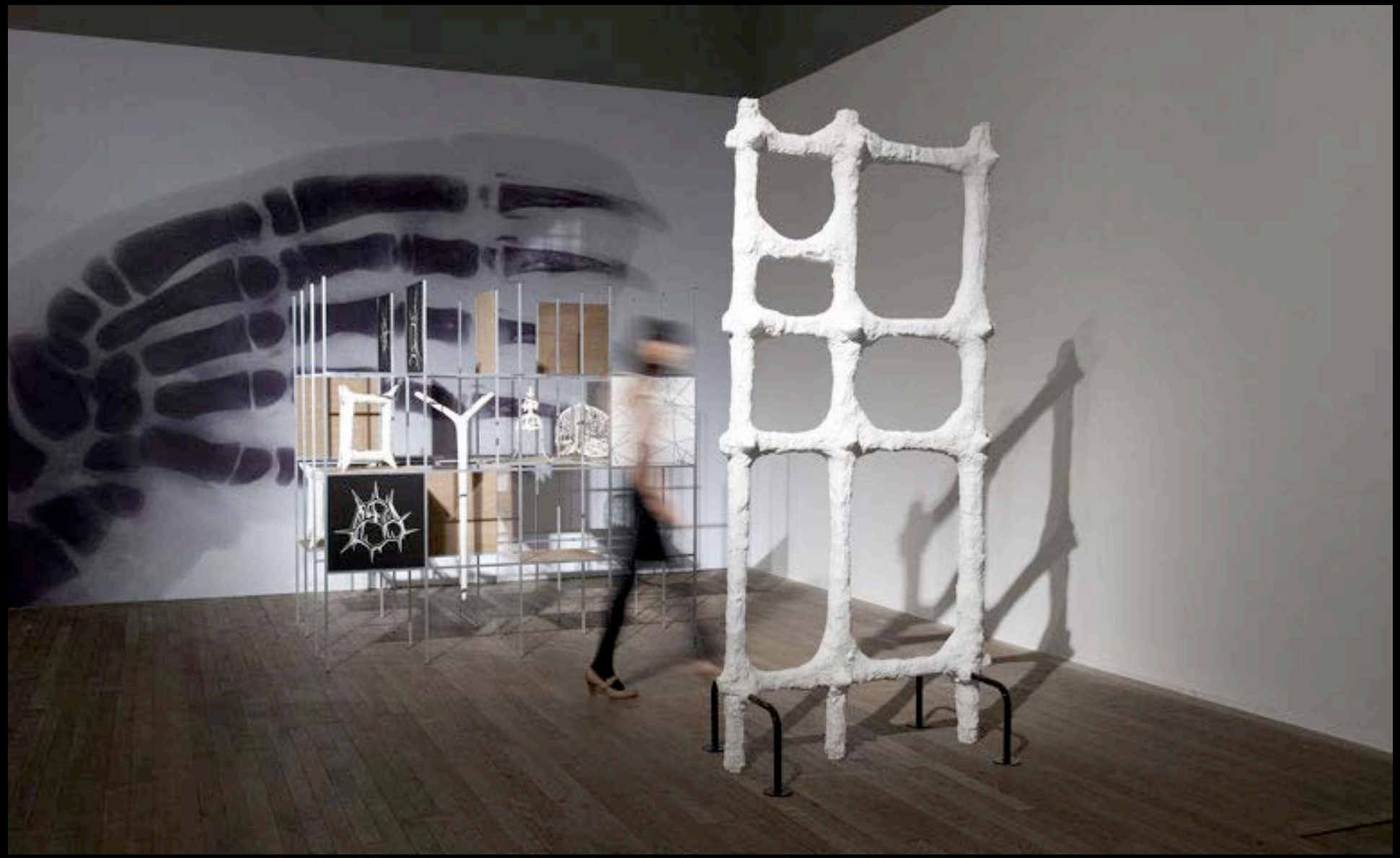
Right: Cover used by McHale as illlustration

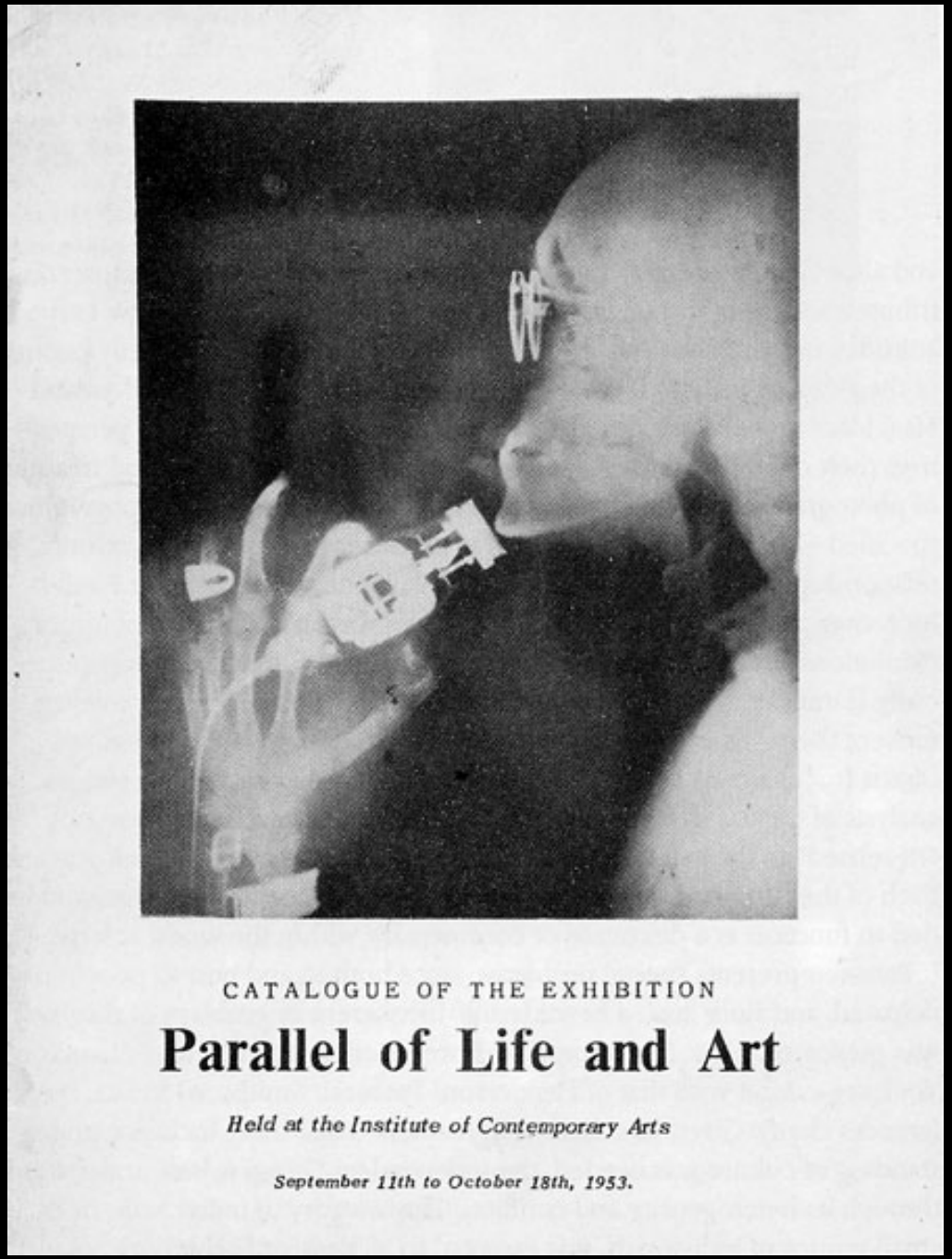


Independent Group, London

Exhibition: Growth and Form, 1951

Institute for Contemporary Art





Independent Group, London

Exhibition: Parallel of Life and Art, 1953

Catalog cover

Independent Group, London

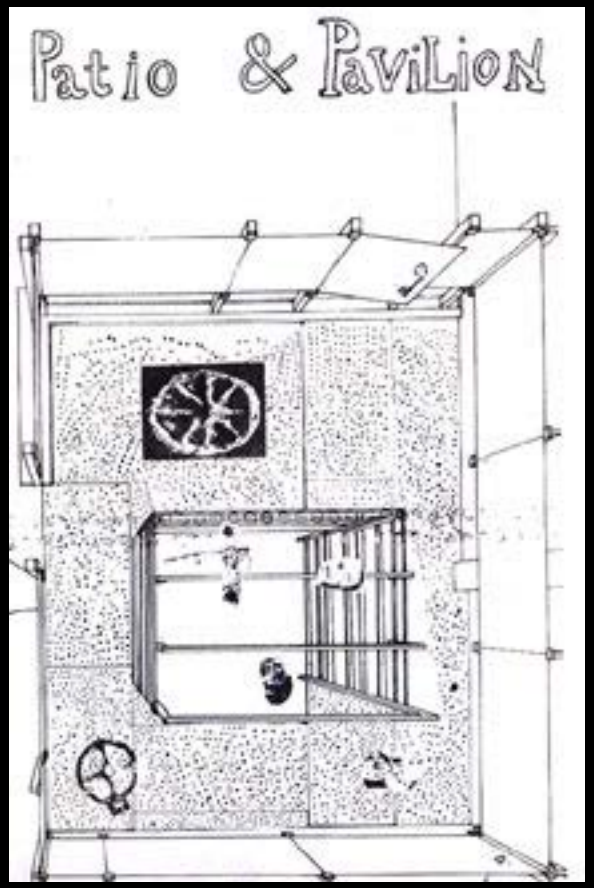
Exhibition: Parallel of Life and Art, 1953

Institute for Contemporary Art

Independent Group, London

Exhibition: This is Tomorrow, 1956

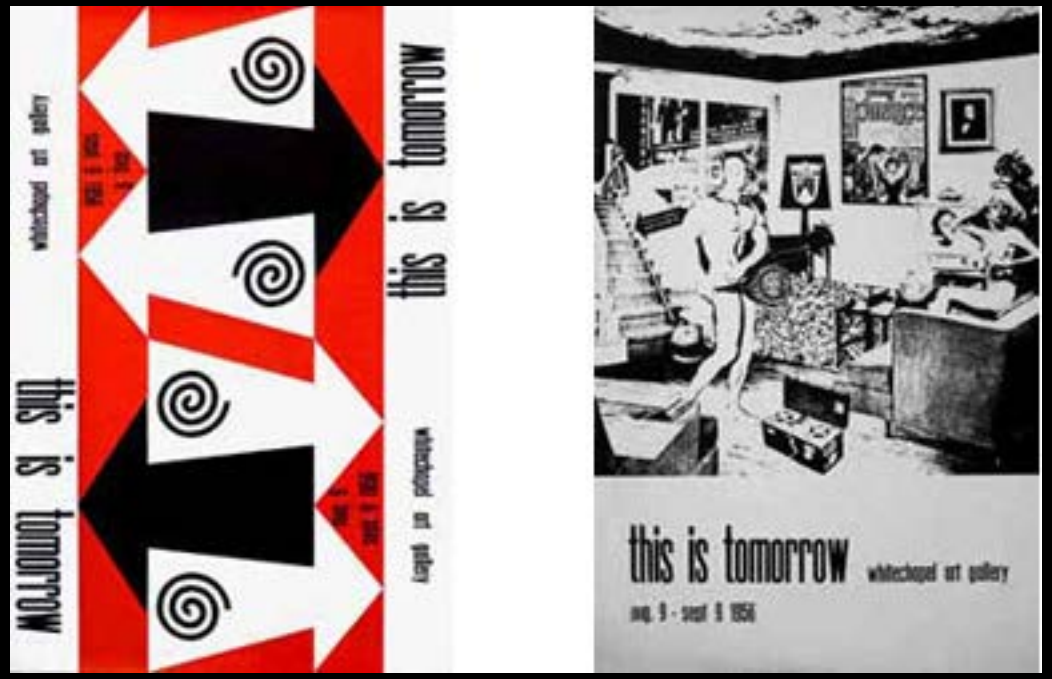
Institute for Contemporary Art



Alison and Peter Smithson, Plan for Patio and Pavilion,

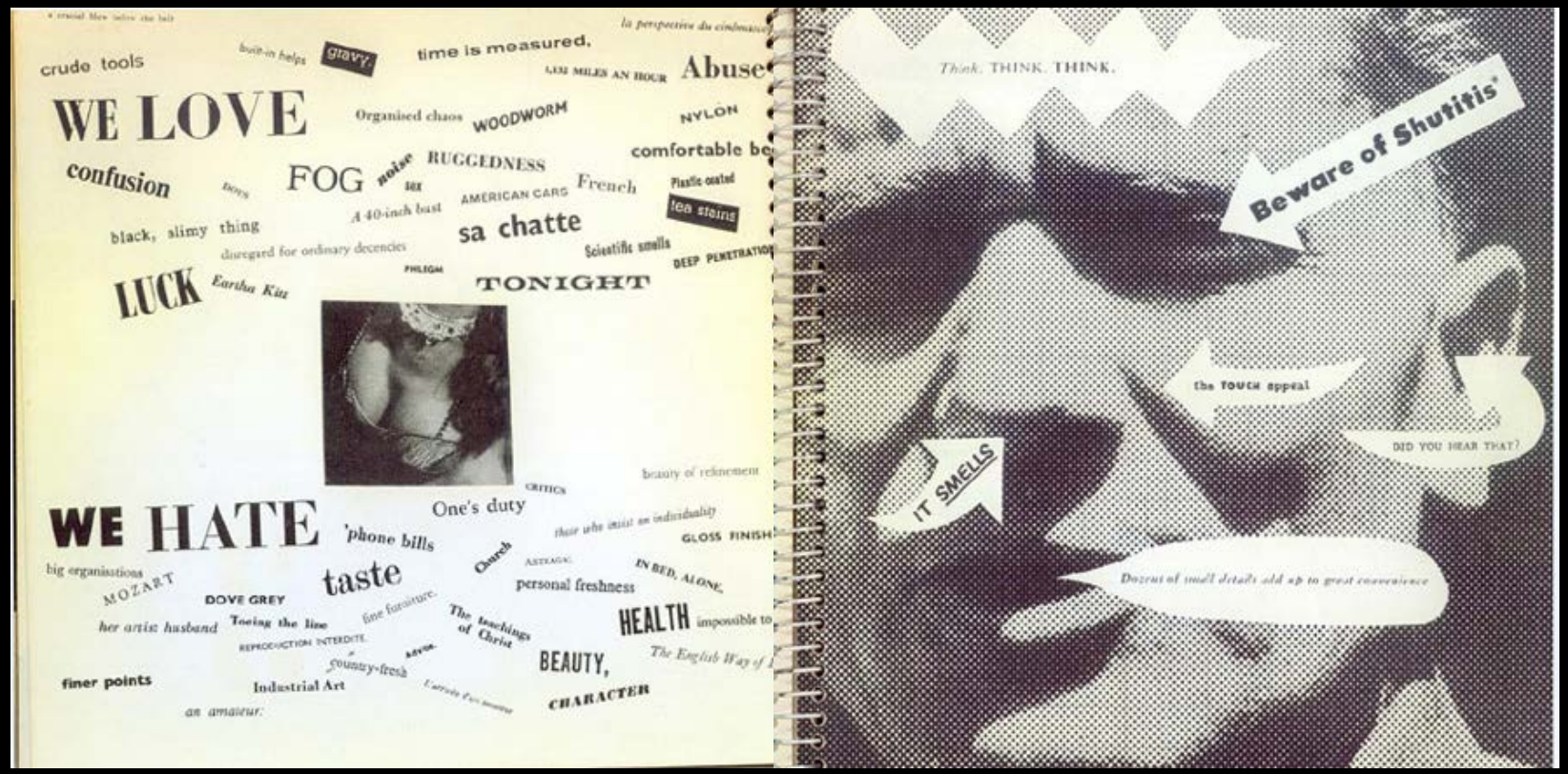
This is Tomorrow, 1956

Nigel Henderson and Edouardo Paolozzi, Patio and Pavilion, This is Tomorrow, 1956



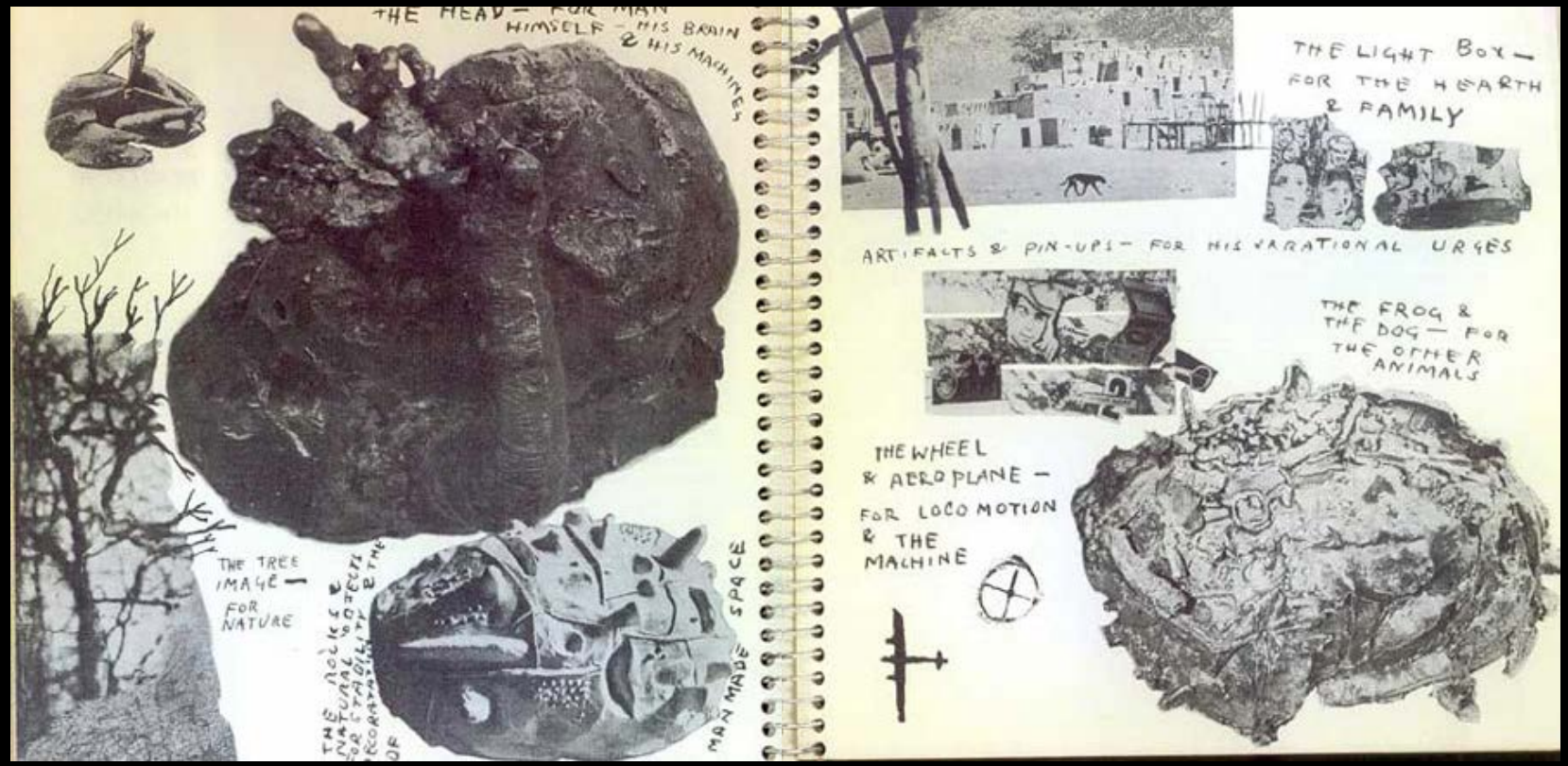
Print Matter from This is Tomorrow, 1956

cover of catalog left and adverts right



Print matter from catalog for This is Tomorrow, 1956

Left, Untitled Collage, Right Richard Hamilton, “Collage of the Senses,” 1956



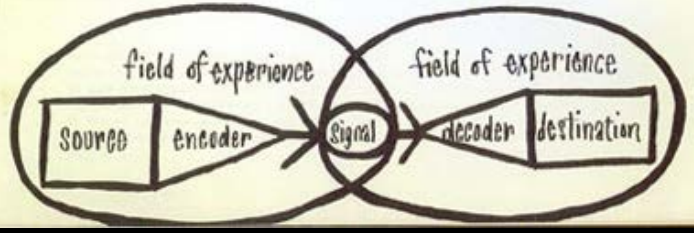
Pages from catalog for This is Tomorrow, 1956

THIS section of This Is Tomorrow represents the basis of collaboration between architect and artist as part of a general human activity rather than as the reconciliation of specialised æsthetic systems. It is communications research which offers a means of talking about human activities (including art and architecture) without dividing them into compartments. Hitherto the conventional definition of

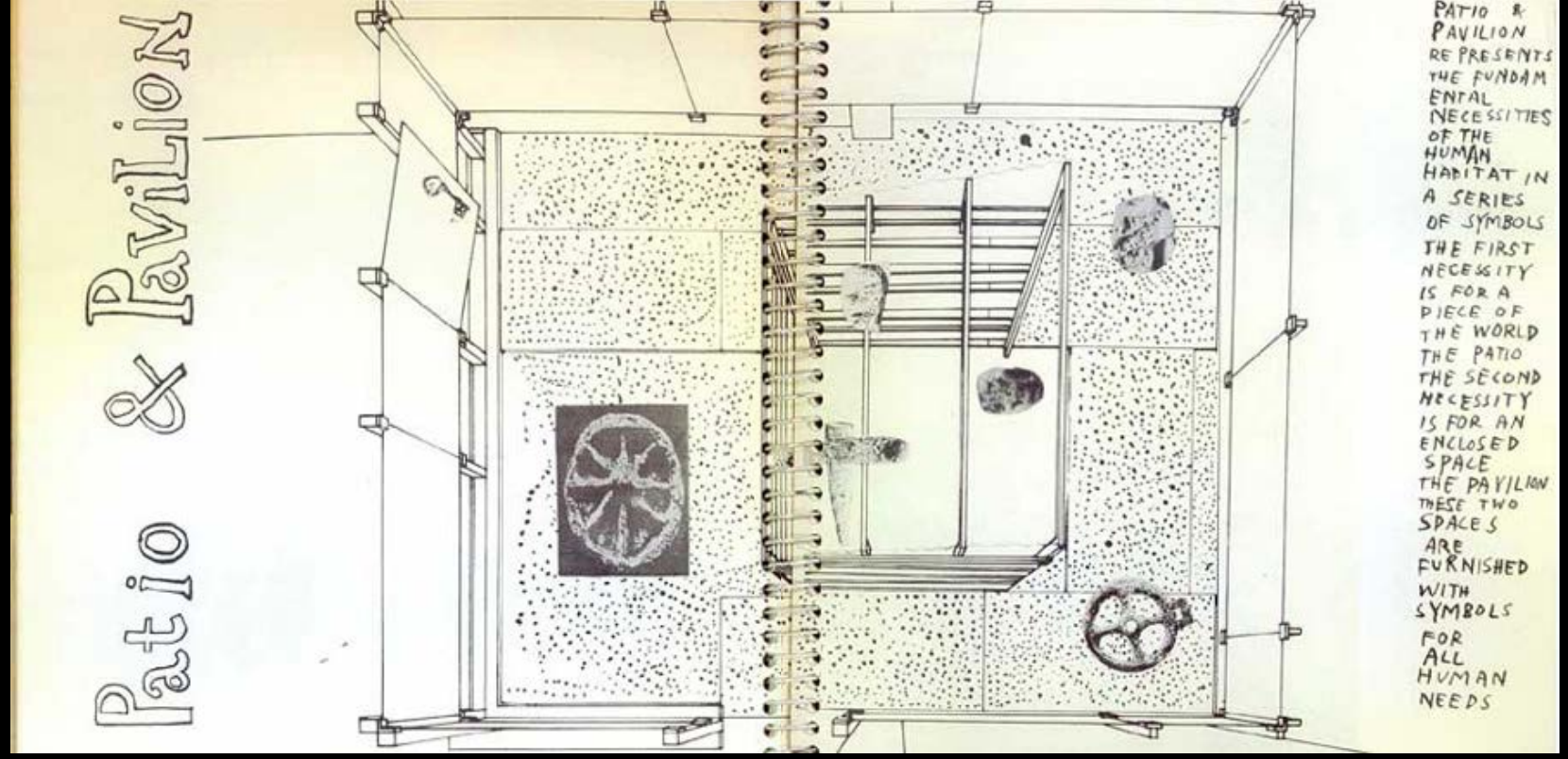
All communication depends on the transmission of signs. Fig. 1 is a simple diagram of a communication system. In an efficient communication system the field of accumulated experience must be similar in encoder and decoder (see Fig. 2), because without learned responses there is no communication. However, learned responses become stereotyped and stale in time and need to be revised.

the artist and architect has limited their efficiency to narrow mutually exclusive areas. It is this that has made collaboration difficult. Seeing art and architecture in the general framework of communications, however, can reduce these difficulties by a new sense of what is important.

GEOFFREY HOLROYD, TONI DEL RENZIO, LAWRENCE ALLOWAY.

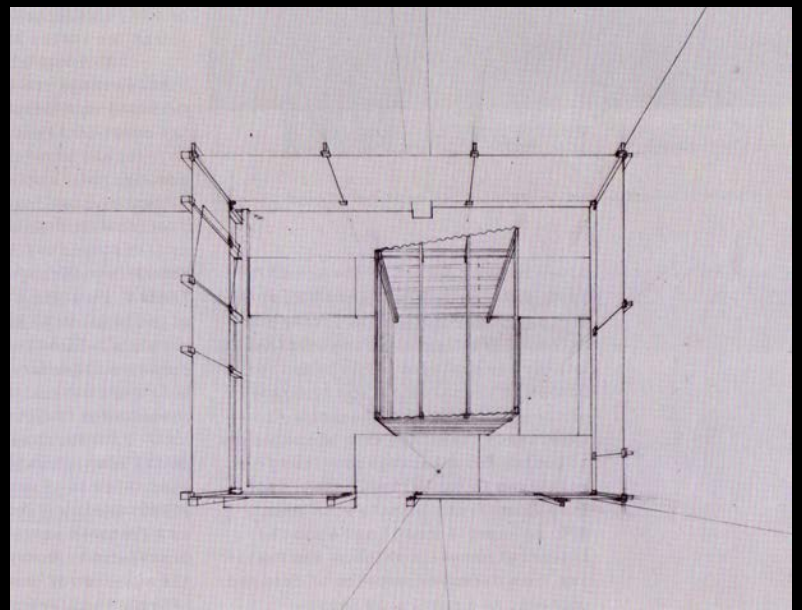


Pages from catalog, This is Tomorrow, 1956



Pages from catalog, This is Tomorrow, 1956

Peter and Alison Smithson, Drawing for Patio and Pavilion



Richard Hamilton

"What Is It That Makes Today's Homes So Different? So Appealing?"

1956

Richard Hamilton, $he, 1958-61; oil and collage on panel

1

2

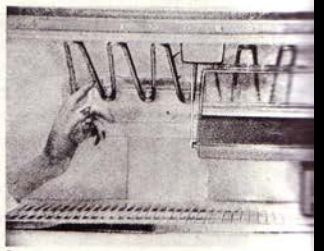
3

Now
FRIGIDAIRE
brings you
FREEZING
WITHOUT
FROSTING
in the 1939
FROST-PROOF
Refrigerator-Freezers!

4

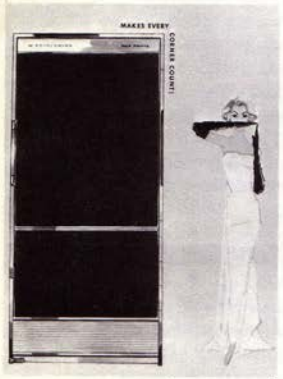
7

6



8

MAKES EVERY
COOK HAPPY



5

PICKS UP MORE
DIRT...FASTER!

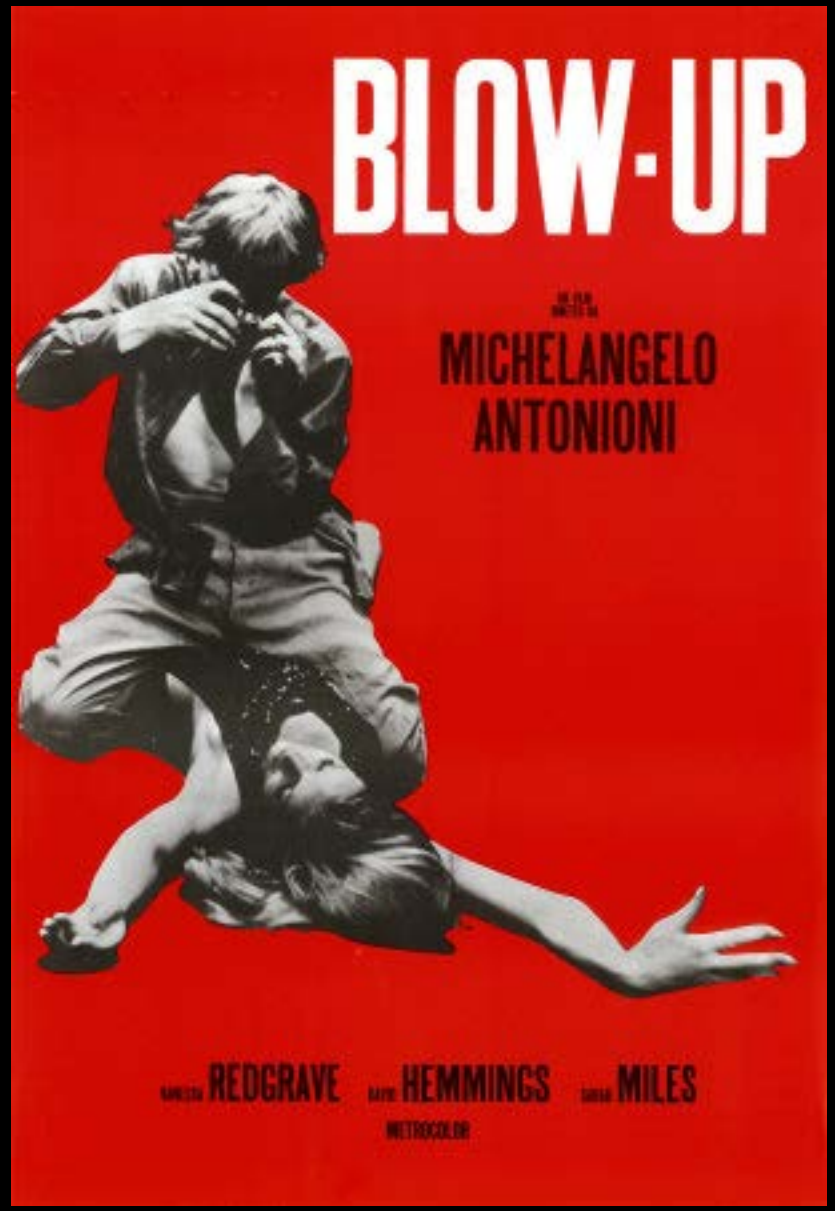
New Westinghouse
Speed Cleaner!

9

10

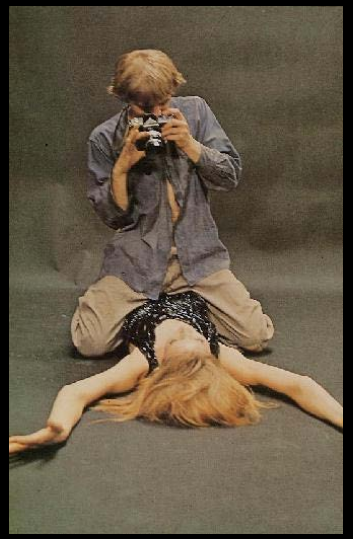
Richard Hamilton, Swingeing London, 1967

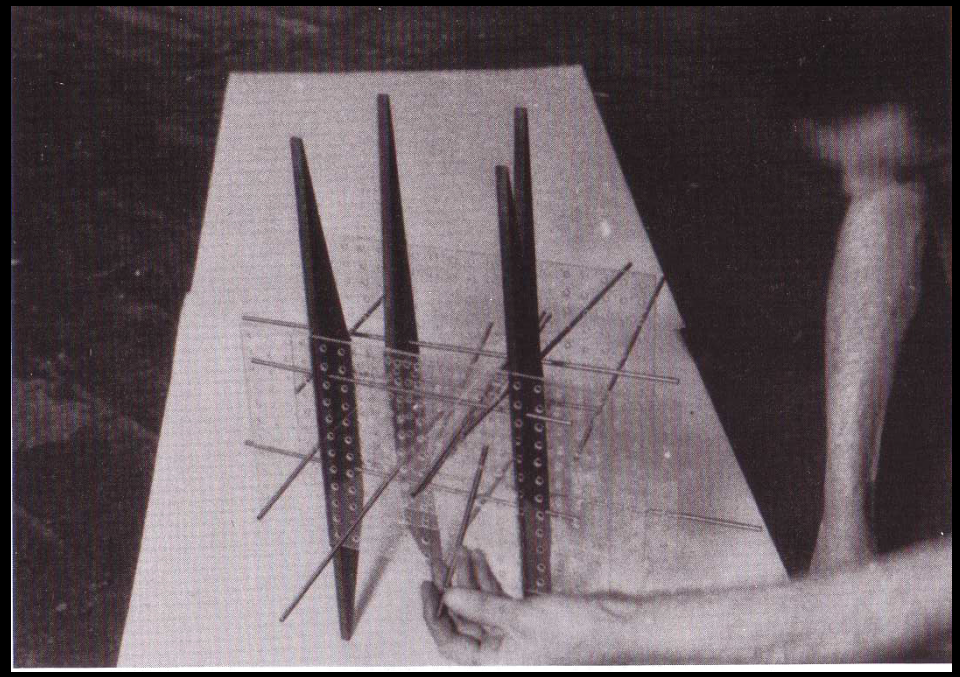
Richard Hamilton, Swingeing London 67 (1968)

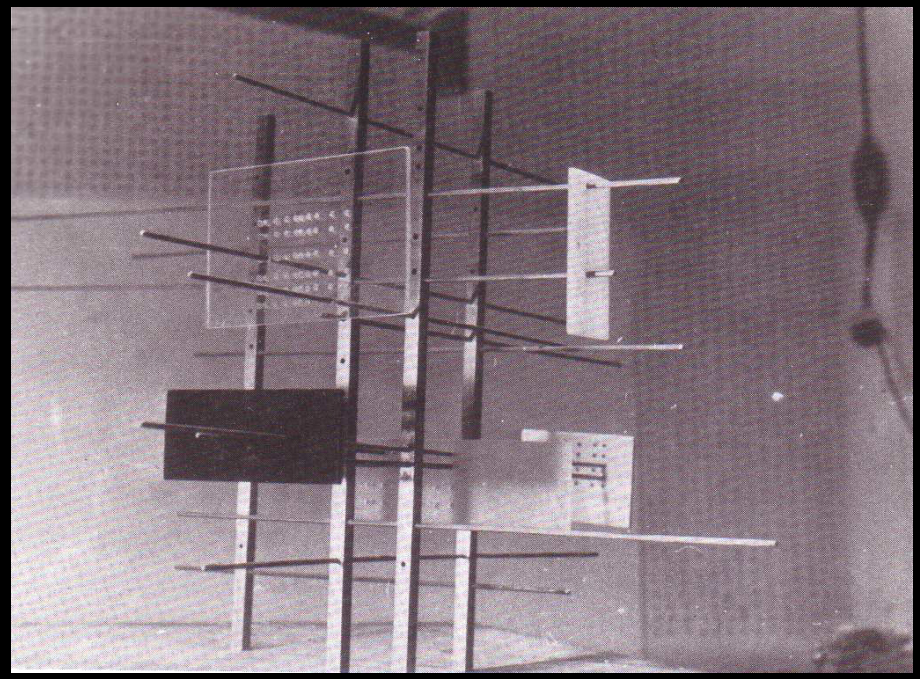


"Swinging London"

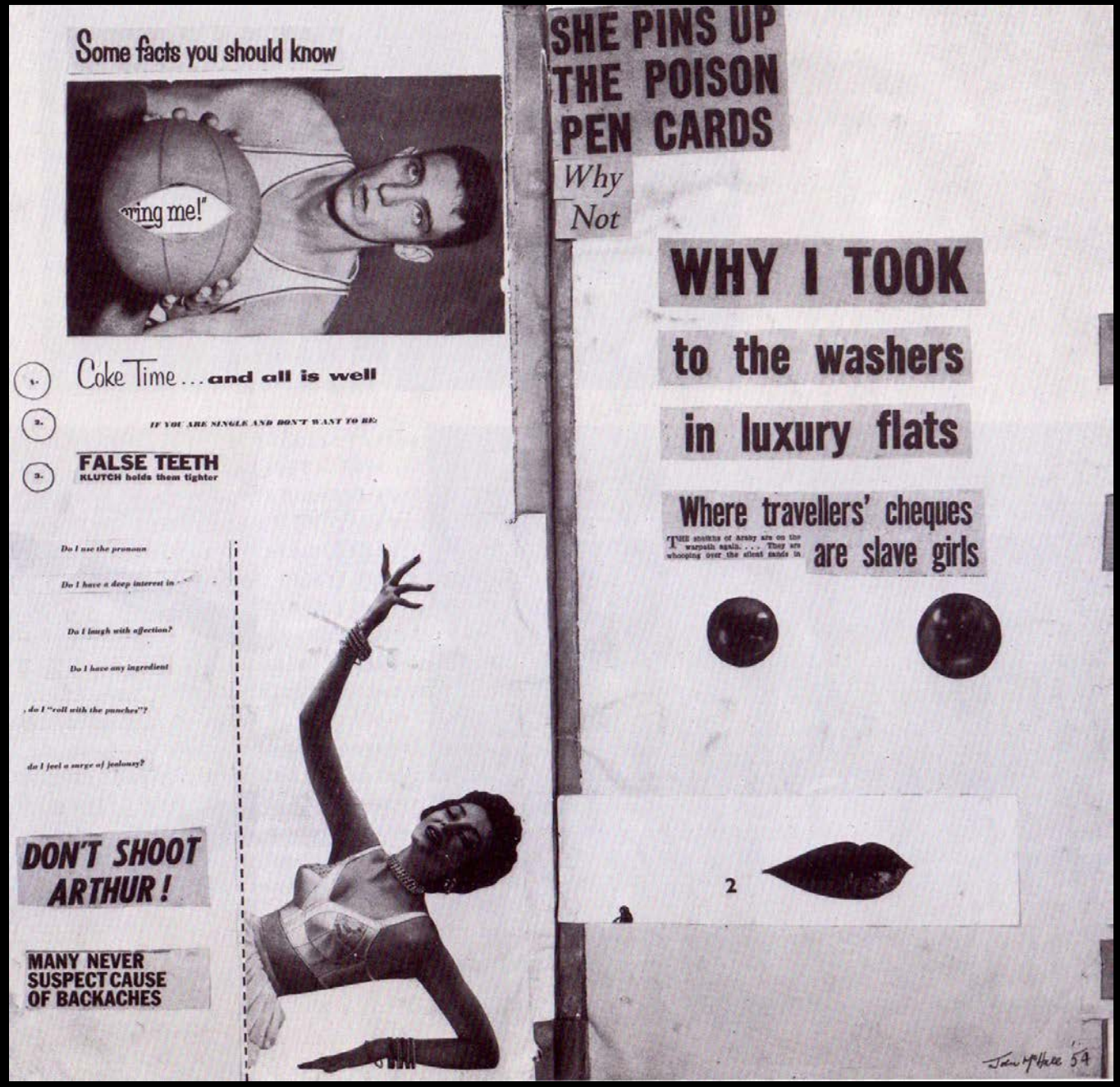
1960s





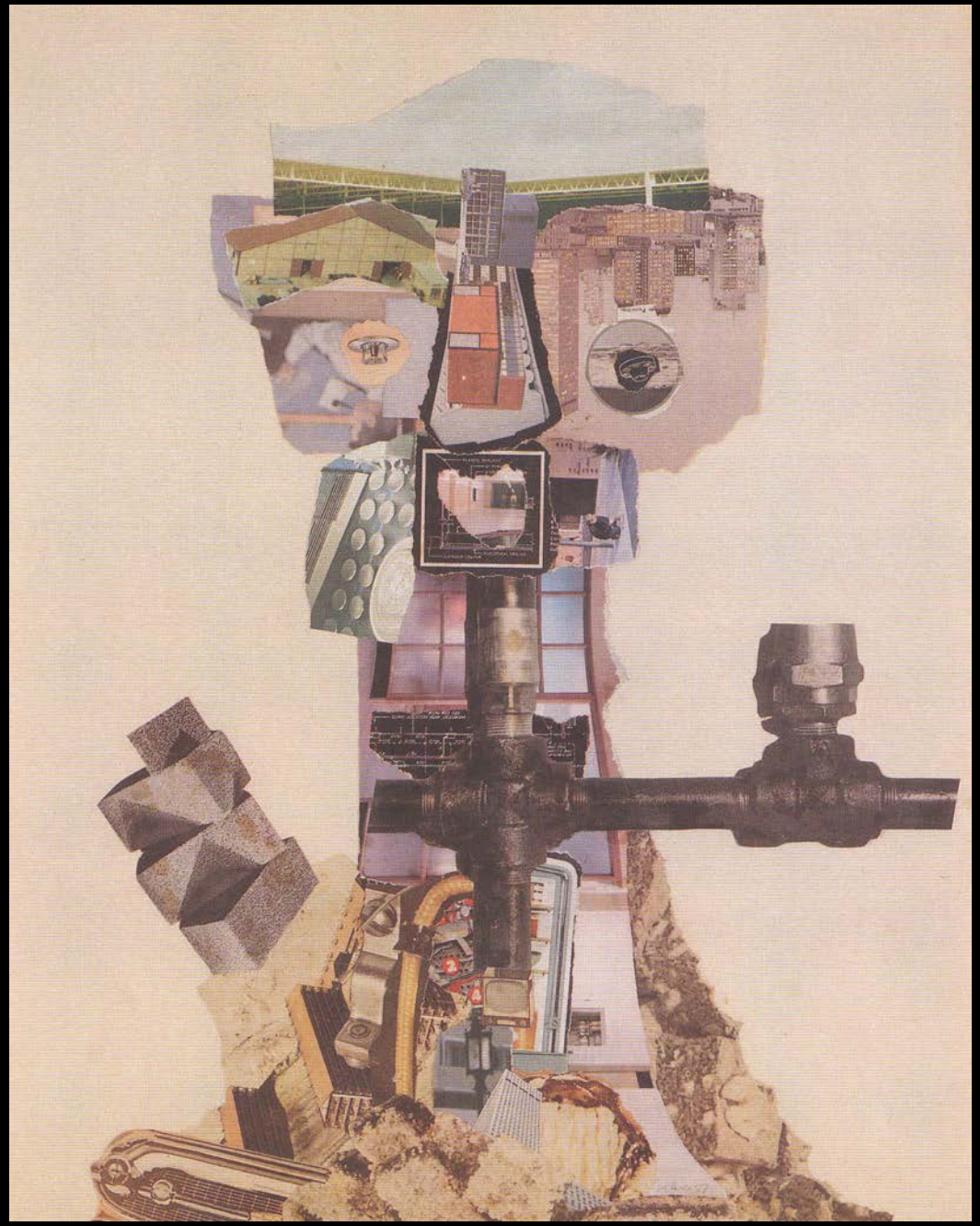


John McHale, Construction Kits, 1954



John McHale, "Why I Took to the Washers

In Luxury Flats," 1954, collage book



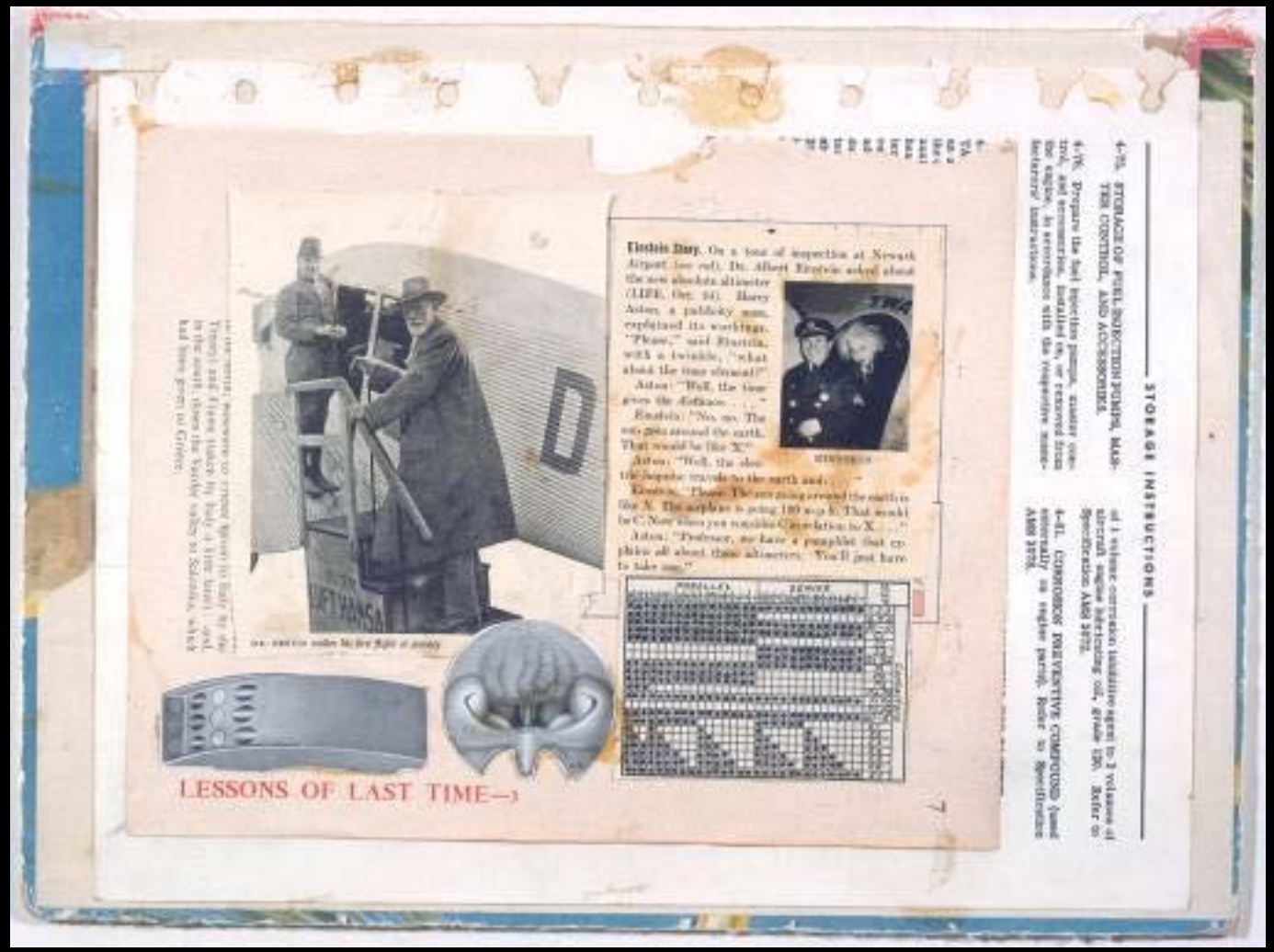
John McHale, “Machine-Made America I,”
1956-57, collage

Eduardo Paolozzi

"I Was a Rich Man's Plaything"

from *Bunk*

1947



Eduardo Paolozzi, “Lessons of Last Time,” from *Bunk,* 1947

Eduardo Paolozzi

“Meet the People”

From *Bunk*

1948

Eduardo Paolozzi

“Will Man Outgrow Earth?”

From *Bunk*

1948

Eduardo Paolozzi
“Fountain”
1951-52
Steel, copper alloy and paint

Eduardo Paolozzi
“Cyclops”
1957
Bronze

Magda Cordell

“Skin”

1956

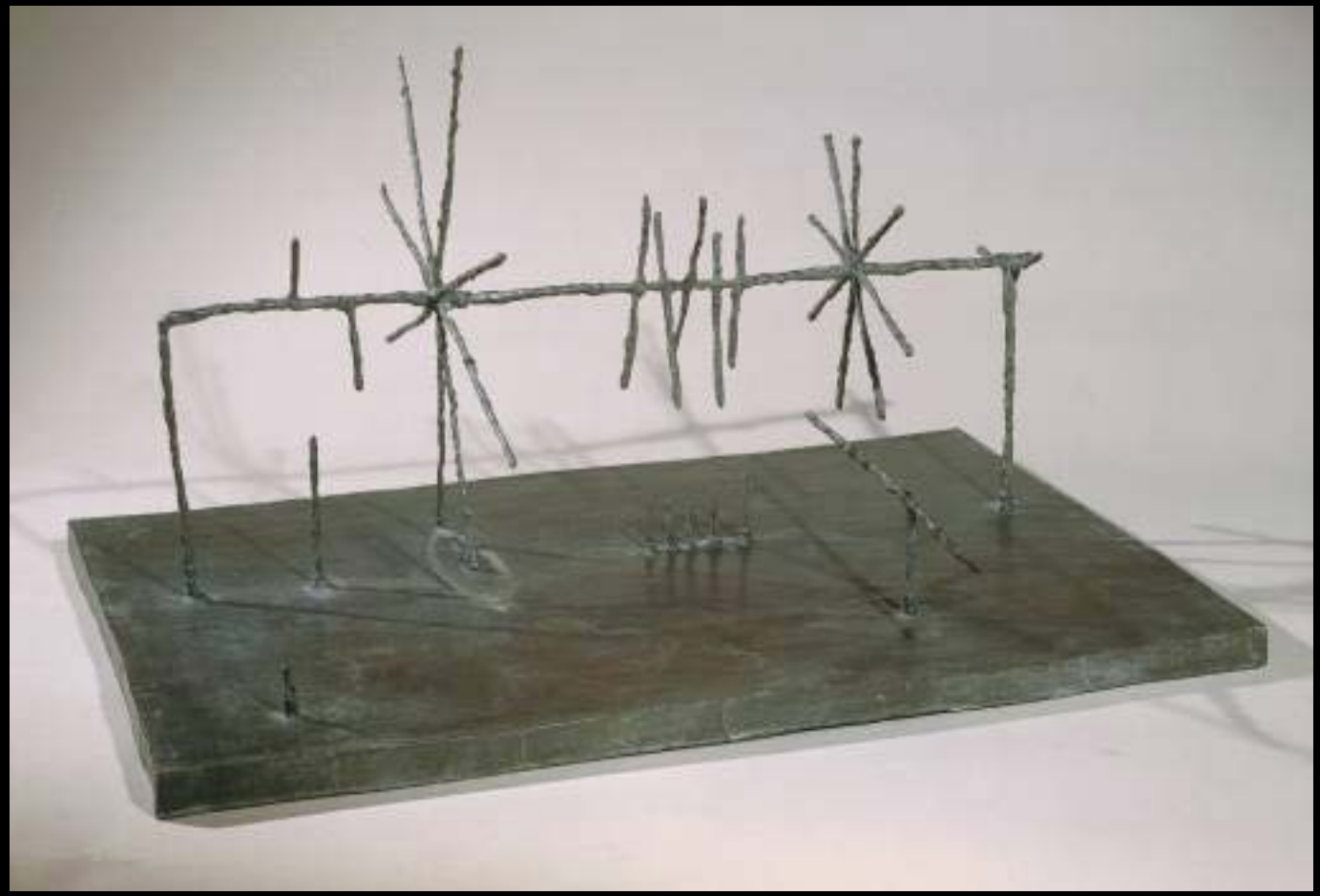
Mixed Media on Board

Magda Cordell

“Figure II”

1956

Mixed Media on Board



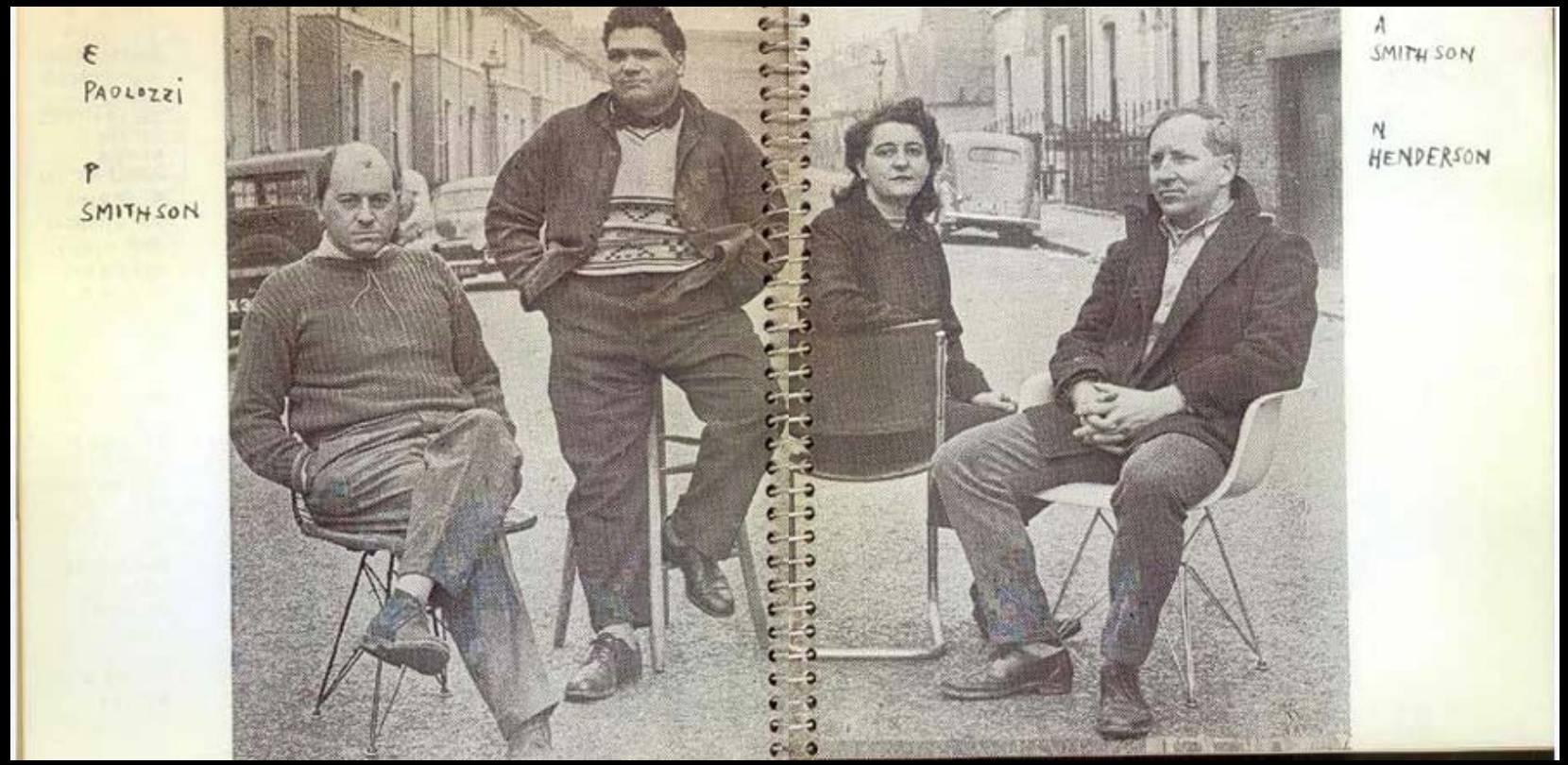
William Turnbull, Mobile Stabile, 1949, Bronze

William Turnbull

“Mask I”

1953

Bronze



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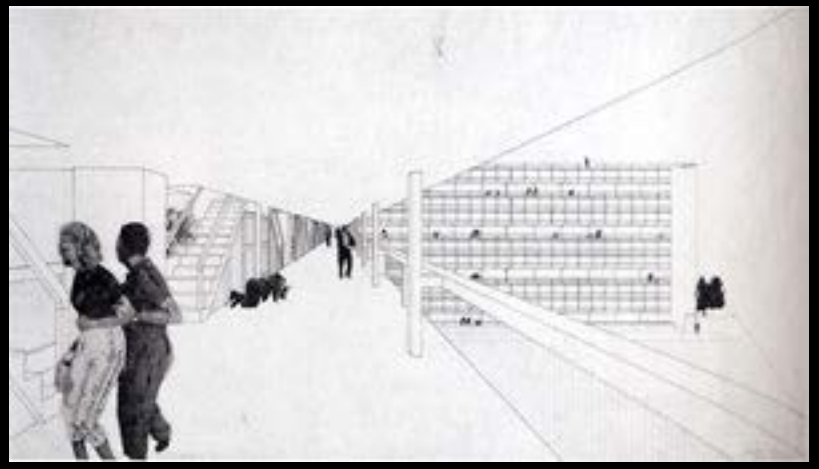
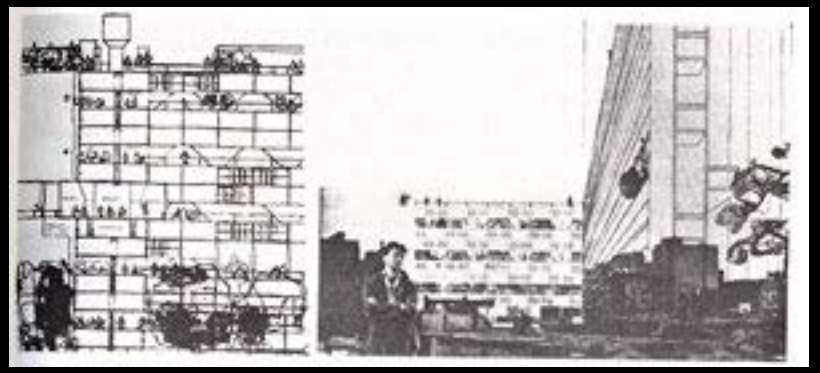
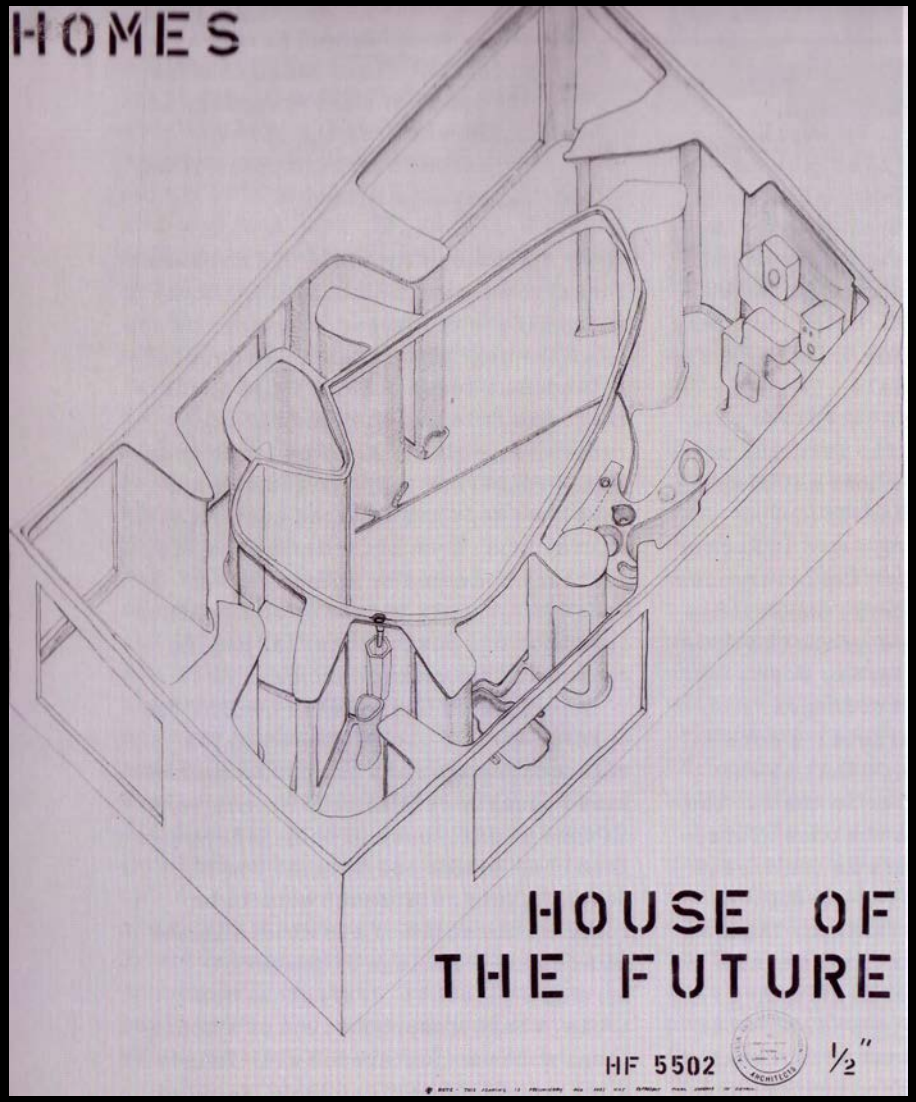




Peter and Alison Smithson, Competition Submission for the Golden Lane Housing Project, 1952

Peter and Alison Smithson, Golden Lane Housing Project, 1952, collage, photographs, magazine cutouts, and pen on paper



Peter and Alison Smithson, Axonometric of the House of the Future, 1956, Daily Mail Idea Home Exhibition

Peter and Alison Smithson, House of the Future, 1956,

Daily Mail Idea Home Exhibition

Peter and Alison Smithson, House of the Future, March, 1956,

Daily Mail Idea Home Exhibition

Peter and Alison Smithson, House of the Future, March, 1956,

Daily Mail Idea Home Exhibition