

Theoretical and Philosophical Aspects of Biomimetic Urbanism

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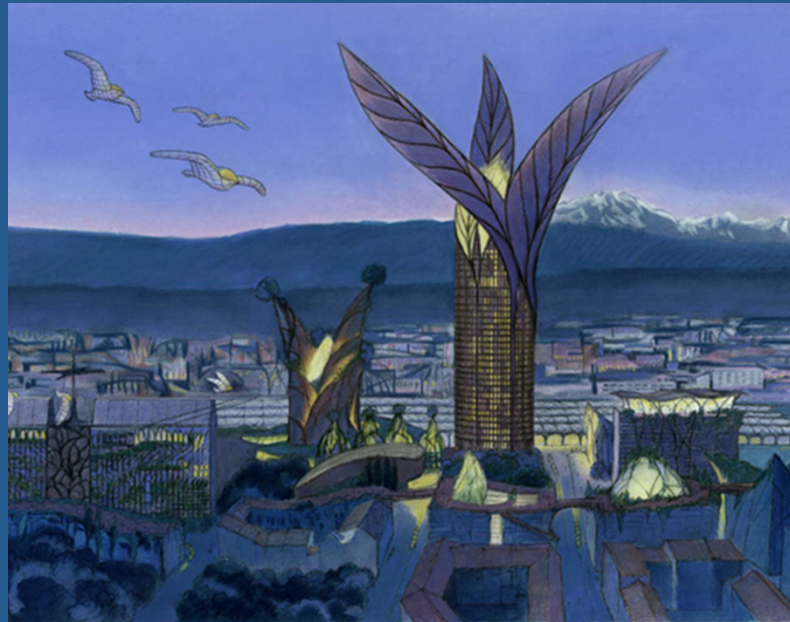
Introduction

Two areas of research

- i) Philosophy of biomimicry
- ii) Application to city

VIBIOM: IrPhil (Lyon 3), DEEP/CETHIL/BiG (INSA)

Visions and projects in biomimetic urbanism



THEORY, PHILOSOPHY, AND SCOPE OF BIOMIMICRY

What is biomimicry?

J. Benyus, *Biomimicry: Innovation Inspired by Nature* (1997)

- Nature as model: imitation or inspiration
- Nature as measure: ecological standards
- Nature as mentor: learning from nature
- Nature of Nature?

Philosophical Framework (Dicks 2016)

Nature as Model
(*Technology*)



Nature as Measure
(*Ethics*)



Nature as Mentor
(*Epistemology*)



Nature of Nature
(*Ontology*)

Scope of Biomimicry

“Organising concept” (Marshall and Loveza 2009)

i) Biological biomimicry

- Biomimetics + Bio-inspiration: materials, forms, processes, systems
- Bionics: robotics and AI

ii) Ecosystem biomimicry

- Agro-ecology (e.g., permaculture, organic farming)
- Analogue forestry
- Industrial ecology
- Ecological engineering
- Restoration ecology (?)

Application to Cities I

NATURE AS MODEL

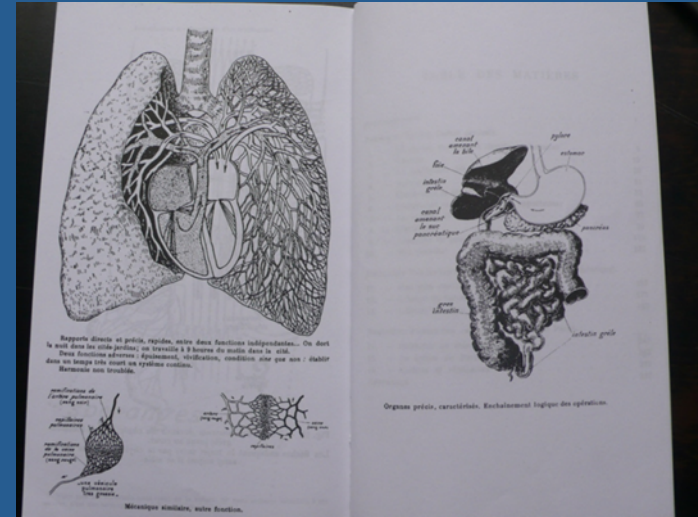
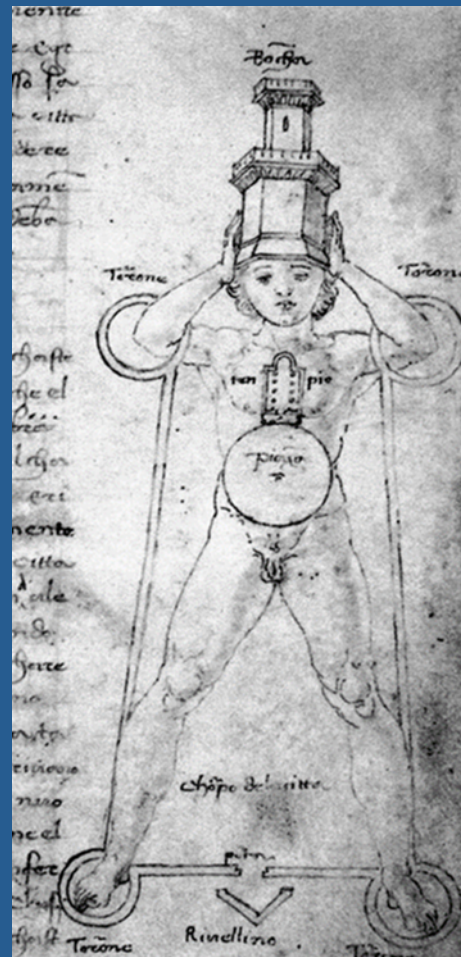
“Nature as model. Biomimicry is a new science that studies nature’s models and then imitates or takes inspiration from these designs and processes to solve human problems, e.g., a solar cell inspired by a leaf.”

J. BENYUS

What Model(s)?

- What model? Organism? Nests of Social Insect? Ecosystem? (What ecosystem?)
- How understand model? (→ nature of nature)
- Single model? Multiple models? Integrate at what level?
- What stays the same and what is different at different levels of organization or at different scales? (e.g., spatial optimization)

City as (Human) Organism (Dicks 2017a)



Three ways of understanding ecosystems

1. Process-Functional Approach (Tansley, Odum)
 - Nutrient-cycling, energy flows, etc.
2. Population-Community Approach
 - Unit-association theory: emphasis on discrete patches defined by dominant types of vegetation (Clements)
 - Individualism: emphasis on continuum of individuals (Gleason)
3. Hierarchy theory (O'Neill, Allen)
 - Importance of role of observer
 - Importance of levels of organization

Consequences for biomimetic urbanism

1. Process-functional approach

- Imitating nutrient cycling, energy flows (generation, storage, distribution...)

2. Population-community approach

- Imitating native ecosystem (understood as a unit-association)
- Openness to other models at lower levels (e.g., termites nests → passive cooling / sea sponges → fibre optics)

3. Hierarchy theory

- Importance of observer
- Importance of different levels

Eastage Centre, Zimbabwe



Callebaut – Gare du Nord



Application to Cities II

NATURE AS MEASURE

“Nature as measure. Biomimicry uses an ecological standard to judge the “rightness” of our innovation. After 3.8 billion years of evolution, nature has learned: What works. What is appropriate. What lasts.”

J. BENYUS

The Ecosystem Services Analysis (ESA) Approach

Pedersen Zari (2012, 2015)

- ESA: native ecosystem
- ESA: current city (Wellington)
- ESA (speculative): future bio-inspired city

ESA Results

(Pedersen Zari 2015, simplified)

Ecosystem service	% of Service pre-development ecosystem	% of service provided by Wellington City	% of service provided by future bio-inspired Wellington	How (one example)
Habitat provision	100	2	10	More green space
Nutrient cycling	80	0	80	Separate waste streams
Purification	100	13	100	Increased urban vegetation
Climate regulation	100	5	15	Regeneration of forest
Provision of fuel/energy	100	19	286	Transition to renewables
Provision of fresh water	100	0	80	Rainwater harvesting
Provision of food	100	0	11	Urban food growing around residences

Theoretical and Methodological Issues in the ESA Approach

I. View of nature?

- Process-functional (not population-community), no real interest in imitating species or species interactions
- Anthropocentric (ecosystem *services*). Response: drop provisioning services?

II. Nature as measure

- Standards drawn from native ecosystem*

III. Existing technologies

- But what about development of new technologies?

“The application of ecosystem services analysis to regenerative design has significant philosophical implications because it asks design teams to judge their environmental performance goals in comparison with the best an ecosystem could do (or did do) on the same site and in the same climate.”

PEDERSEN ZARI (2012, P.62)

Application to Cities III

NATURE AS MENTOR

*“Nature as mentor. Biomimicry is a new way of viewing and valuing nature. It introduces an era based not on what we can *extract* from the natural world, but on what we can *learn* from it.”*

J. BENYUS

A New Way of Viewing Nature

- Learning *about*: nature as object of knowledge
- Learning *from*: nature as source of knowledge
- Similar transformation in environmental ethics: nature as object to nature as source (Dicks 2017b)
- Also true of technology: nature as object to nature as source

The « Old » View of Nature



Fig.2 Nature as Object

The « New » View of Nature

Technology



Ethics



Knowledge



Nature

Fig.3 Nature as Source

New Tasks for Ecology

Two Tasks of Ecology (Sagoff 1985)

1. Managing ecosystems (object of technology)
2. Protecting ecosystems (object of ethics)

Epistemology of learning about Nature

Two New Tasks of Ecology

1. Imitating ecosystems (source of technology)
2. Judging the “rightness” of these imitations
(source of ethics)

Epistemology of learning from Nature

Application to cities

- Ecologists need to embrace a new epistemological relation to nature (learning about → learning from)
- Work with biomimetic urbanists (on the two new tasks)
- Not just a case of « interdisciplinarity »

Conclusion – areas of research

1. Philosophy and theory of biomimicry
2. Application to cities – theoretical foundations of biomimetic urbanism
3. Different sectors (energy, transport, etc.) – articulation/integration
4. Institutional/epistemological issues: natural sciences + engineering, architecture, urbanism
5. Human and social sciences (CESE 2015)

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