Darwinian Reductionism and Genocentrism

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The Ruling Orthodoxy: Physicalist Antireductionism

Antireductionism

- Not a merely an epistemological thesis
- A metaphysical thesis

Physicalism

- All facts are physical facts
- “The physical facts fix all the facts”

What isn't reductionism

Not a thesis about the derivation of laws

There are no biological laws (except the laws, if any, of natural selection)

Not eliminativism

Eliminativism is the ***reductio ad absurdum*** of reductionism

Not a bottom-up research method

Not a Leibnizian thesis that the fundamental physical properties are all monadic, non-relational

What is reductionism

A thesis about biological explanations

minimally, they can always be improved by adding molecular detail, sometimes such detail corrects and makes more adequate

An opportunistic research strategy—top down and bottom up, they will always meet! No barrier between

Antireductionism: what it is and is not

What it is not:

Not a thesis about the underivability of biological laws—there are no such laws

Not a thesis about our cognitive/computational limits or our current conceptual scheme

What it is:

A thesis about explanations: many non-molecular explanations are fully adequate

There is a barrier to top-down and bottom up research

Antireductionism's barrier

Multiple realizability of higher level kinds makes them irreducible

This is an ontological thesis—about natural kinds—property holism

Source of multiple realizability: the operation of natural selection—the biological process ***par excellence***

Natural selection is blind to differences in structure

Natural selection = blind variation + environmental filtration

There are almost always 2 or more physically different but equally good solutions to any design problem

Environmental filtration cannot discriminate between two equally fit design solutions

Ergo, multiple realizability of the biological

Exceptions prove the rule

DNA appears to be the sole solution to the design problem of high fidelity information transmission.

As such, it provokes an arms race, as nature searches design space for something to exploit DNA's role in info transmission

Results: RNA genes, methylation-genetic imprinting, prions

Evolutionary arms races make biological laws impossible

Is natural selection an ontological barrier to reduction?

Three alternatives

1. Natural selection is not a physical process—antireduction vindicated
2. Natural selection is a derivable consequence of the operation of physical laws—reduction vindicated
3. Natural selection is a basic, underived physical process—reduction vindicated

Which alternative?

1. is incompatible with physicalism--too high a price to pay for antireductionism?

2. is not an option owing to multiple realizability of fitness—cant latch on to any set of physical properties
3. Can be vindicated by a reductionistic research program working from bottom up

What is genocentrism?

- A thesis distinct from reductionism
  - Reductionism is not nucleic acid chauvinism
- Explanation of development is reductionistic
- The genes have a special role to play in development
- The genes program the embryo

Questions: what is reductionism

what is “programming”

Development is (literally) Programmed by the Genes

- Follows a structured Boolean program
- We know the program for ***Drosophila*** at the level of structural and regulatory genes
- We are learning the "machine code" program at the level of DNA sequences that code for specific regulatory proteins, microRNAs, Ribosomal RNAs, and structural proteins.

Five challenges to Genocentrism

1. Contra-induction
2. Antireductionism
3. Denial of the special role of the gene
4. Against the informational programming role of the genes
5. Rejecting the univocal gene

1. Contra-induction

Why suppose that the rest of the details of ***Drosophila*** development and behavior are equally intelligible from a purely macromolecular perspective? Why suppose that development among vertebrates should be anything like ***Drosophila*** embryogenesis? Is it reasonable to claim that a macromolecular program will explain development everywhere and always?

2. Contra reductionism

Why suppose that the whole story is macromolecular? If the role of whole cells is indispensable to the program for ***Drosophila*** embryogenesis, then reductionism's explanatory claim must be surrendered.

[Kitcher, 1953, Laubichler and Wagner, 2001]

4. Against the Informational Programming Role of the Genes

Genocentrists ground the special explanatory status of the genes on their roles in an informational program. But the gene does not bear any special informational role in any biological process. The intentional idiom of molecular biology is metaphor run amok.

[Griffiths, Griffiths and Grey, Griffiths and Stolz, Griffiths and Neuman-Held]

3. Contra Genocentrism: the causal democracy thesis

Why suppose that the genes have any special role in development? There is a vast range of other conditions—physiological and environmental—causally necessary for fertilization and embryogenesis along with the products of the genes.

Each of these casually necessary factors is on a par with the others, none is even *primus inter pares*.

Accordingly "genocentrism" the attribution of a special role in development to the genes, is unwarranted.

[Griffiths and Grey, 1994]

5. Replacing the univocal gene

The notion of the gene is itself problematic. The idea that there is a single univocal notion of the gene, and that it allows them to be distinguished, individuated, counted, and otherwise treated as the relevant units of hereditary transmission and developmental control, is mistaken.

The complexities in heredity and development which molecular biology has uncovered make the unitary gene an obsolete idea.

A more adequate notion will undermine genocentrism and reductionism about development

Rejoinders

1. Against counter-induction

Of course genocentrism can be overtaken by events. It has not yet.

It has been strongly confirmed by homologies in development across species, families, genera, families, orders and kingdoms, e.g. eyeless

It has been confirmed by variations within genera—long germ band/short germ band insects

2. Against antireductionism

- Does the genetic software require irreducible hardware?
- “1953 and all that”:

  “we find examples on which claims at a more fundamental level (specifically claims about gene expression) are to be explained in terms of claims at a less fundamental level (specifically, descriptions of the relative positions of pertinent cells).”

Paul Griffith's students respond

G. Frost Arnold [2004], "How to be an anti-reductionist about developmental biology: Response to Laubichler and Wagner", Biology and Philosophy, 2004

Megan Delanty, "Emergent Properties and the Context Objection to Reduction", Biology and Philosophy, 2006

3. Defending genocentrism

Is epigenetic transmission a counterexample to the special role of the gene in heredity and development?

Methylation, genomic imprinting, and arms races

Bird-song epigenesis and arms races

epigenesis as an extended phenotype

4. Programming without original intentionality

Computers don't literally contain information—semantic meaning

Ergo, DNA does not need to do so in order to (literally) implement a program

Programming requires:

a) multiple realizability of software

d) reprogrammability of hardware

In the biosphere, only DNA does both

5. ‘Gene’ is not a natural kind

Therefore, genes

don’t have essences

don’t figure in nomological generalizations

can come in different sizes, have different ***modus operendi***

‘Gene’ is in the end a functional and therefore an evolutionary concept (G and N-H).