Comments on Weber

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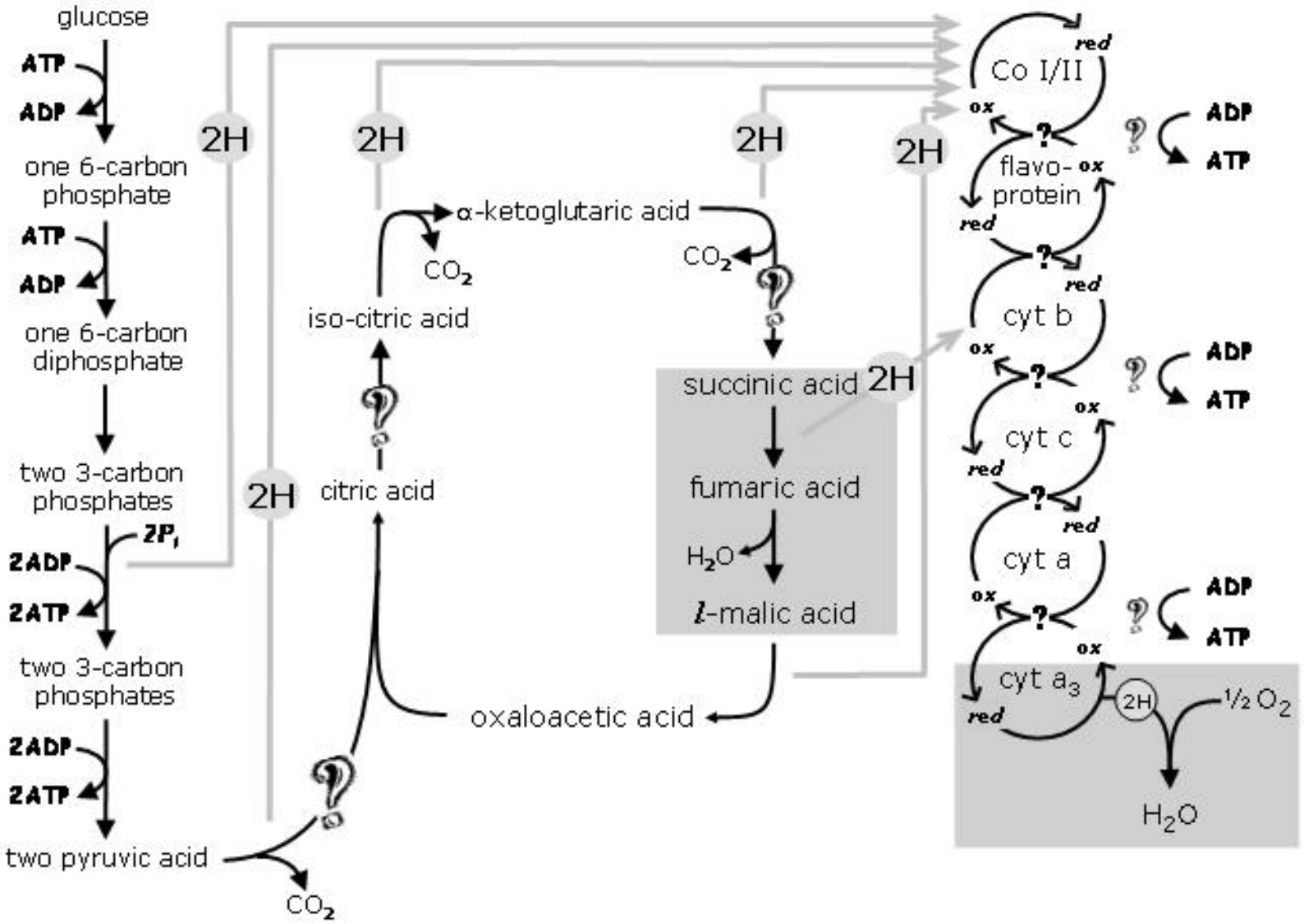
Mere Boundary Conditions?

- Weber:
  - “Explanatory heteronomy: the explanatory principles are not biological in nature (they are physico-chemical). The biological facts provide only the boundary conditions”
- It is the boundary conditions that must be discovered to explain different biological phenomena—the particular:
  - Parts
  - Operations
  - Organization

Mere Boundary Conditions?

- Discovering the parts, operations, and their organization is the work biologists must do to understand mechanisms even as they help themselves to laws from physics and chemistry
- Biological energetics must respect thermodynamic principles
  - An oxidative reaction must involve sufficient release of energy to drive ATP synthesis
- But biologists still needed to discover the parts, operations, and organization involved in the actual biological mechanism


glucose
ATP
ADP
one 6-carbon phosphate
ATP
ADP
one 6-carbon diphosphate
two 3-carbon phosphates
2P$_i$
2ADP
2ATP
two 3-carbon phosphates
2ADP
2ATP
two pyruvic acid
CO$_2$
2H
2H
2H
2H
2H
α-ketoglutaric acid
CO$_2$
iso-citric acid
citric acid
CO$_2$
succinic acid
fumaric acid
H$_2$O
l-malic acid
oxaloacetic acid
Co I/II
flavo- protein
cyt b
cyt c
cyt a
cyt a$_3$
red
ox
ADP
ATP
2H
½ O$_2$
H$_2$O
Glycolysis
Citric Acid Cycle
Respiratory Chain

Mechanisms in Living Organisms

- Weber: How to individuate developing mechanisms when there is no constancy to their components or their organization?
- Even in mechanisms in mature organisms:
  - There is constant turnover of material parts
  - There is often significant reorganization
- Biological systems are far from thermodynamic equilibrium and so much recruit and deploy matter and energy to maintain themselves
  - And must have the resources to alter their organization as needed for different environmental conditions

Mechanisms in Living Organisms

- Living systems are not static, but dynamical
  - Characterizing a mechanism as a static entity is only a first approximation
  - Must then move to the changes that occur as the mechanism performs its function
- Identity for a dynamical system provided by its historical continuity
  - Identify the trajectory of the system through state space
  - One reason boundaries (membranes) are so important
    - Reference point for identifying continuing system even as its components change and it reorganizes

Pragmatics of Explanation

- Weber: What is the mechanism *for*?
  - Assuming that it is for generating the segment pattern of the embryo, why pick out this stage as explanatorily relevant?
- The project of explanation begins with a phenomenon one wants to explain
  - The relevant mechanism is picked out in terms of the characterization of the phenomenon
  - What is really part of a mechanism or an operation in it depends on the phenomenon to be accounted for

Delineating Phenomena

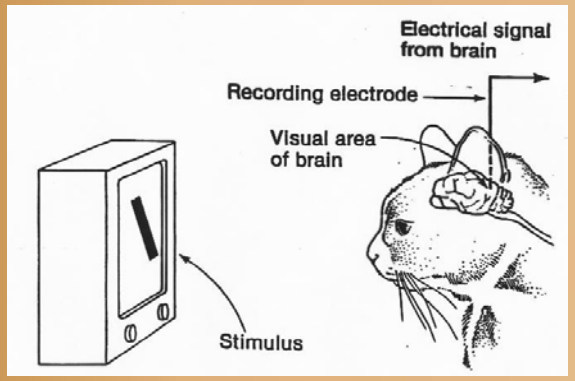
- Phenomena do not come pre-delineated
  - Often a great deal of conceptual and experimental work must be performed to identify the phenomena themselves
- The understanding of the phenomenon may be subject to severe revision as the working of the mechanism is discovered
  - The phenomenon is *reconstituted*

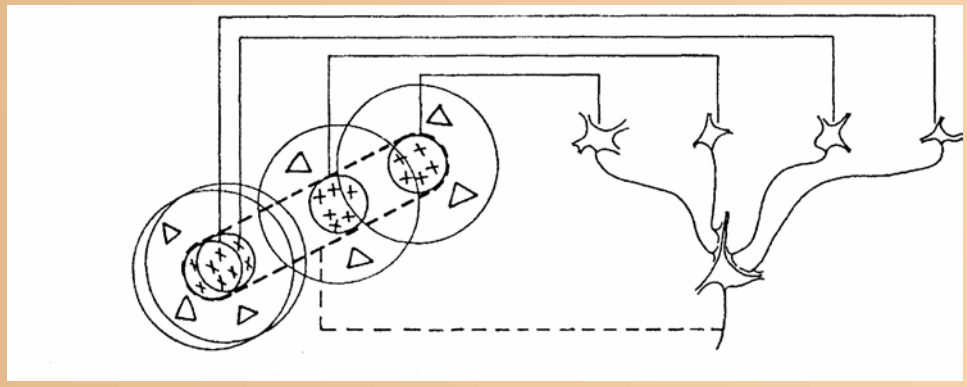
Mechanism vs Computation

- Why are these a contrast case?
  - Mechanisms can perform computations—a Turing machine
  - Mechanisms can embody programs—a von Neumann machine
- Weber: Computation is an intentional notion
  - Some of the parts on which it operates are representations
    - Entities or processes that stand in for other things

Computing Mechanisms

- Neural mechanisms operate on representations
  - Spiking rates or patterns carry information about stimuli
  - The connectivity in the network of neurons allows for processing these representations
  - This connectivity can be highly plastic





Adding a Program

- Gánti felt obliged to add a control system to the chemoton because of the role DNA seemed to play in living systems
  - Building up a polymer that contained information about previous operations
- Griesemer: order of components in polymer is a stoichiometrically free variable