Dynamics of Image Based Science

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1 Image-based-science and Biology

- Science can operate concept-less; images can play a role similar to that of concepts. In particular images can provide public, historically continuous, schemes or frameworks. Images (qua figures) are social, technological, intensional (image-of), public and ritualized objects.
- "Biology" (in the relevant sense), ca. 1880-1930s, but probably also today, was significantly (if not primarily) an "image based science".
- Different sciences, in particular physics and biology handle images differently.
- Biology, being "theory-less" and focused on model-based, functional, explanations, often reifies components of images, and treats them functionally. (Not as approximations.)
- What is not visible, *in the figures, not (merely?) the microscope*, is marginalized as non-functional.

  By fucntional I mean the role the component plays in the encompassing system/mechanism, and the function (yes!) of the system itself. The latter is often stipulated partly based on what is known about the components.
- It follows that images serve both as "observations" and as *implicit models*, leading to an observation-model or description-model duality.

2 "Figures" vs. Images

- "Figures" are Images-Of-(Images-Of-)
- *Public hallucinations*: images that are not things, but are also not purely subjective, because they can be captured on photographs (Van Fraassen, 2008).
- Captured images, which are "graven images", are also "public hallucinations" in a stronger sense than BvF's original sense: they are intentionally and socially constructed. Don't exist as images only as (interpreted) "figures".
- They are cleaned up, may depend on preparation of object, or summarize many images. They come with a description that can use various registers of *representational concepts*; they are <u>not</u> copies.
- They serve as *explanatory models*; they constrain further observations; they are regulative for producing the "same" image again.
- One can opt not to join BvF's "common cause argument" response to Hacking & Salmon (and be a Hacking-style realist), yet go with my claims as far as Images-of-Images-of- are concerned.

3 The Dynamics of Image-Based-Science

1. Can scientific (representational) concepts that are meant to refer to empirical entities be ahead of empirical possibilities, yet still be coherent and scientifically productive?

   I suggest that early observations on cell division and fertilization, in the 1880s, gave rise to empirically grounded and theoretically useful concepts (ca. 1920) that were however ahead of what was actually *observed*.

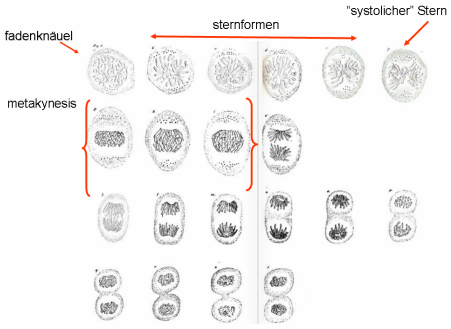
2. How did changes in the genome concept reflect changes in microscopy and later the sequencing of DNA?

   I suggest that as observation improved the genome concept became <u>less</u>, rather than more, empirically grounded in what is actually *observed*.

4 Observation-Model duality

Descriptive (observational) vocabulary

- "fadenknäul", "sternformen"
- Time-series (stages)
- Typically raises empirical questions (e.g., individuation of chromosomes)
- Describe which organism, which stains etc. were used (Images-of-Images-Of)



Flemming (1882)

Model

- 2D (not 3D)
- Lines (in image) → Linear (necessary qua image)
- Stages (in images) → stages of a process
- Optical resolution → level of functional explanation (necessary qua image)
- What's not in the image is not needed for functional explanation
- Typically raises functional questions (e.g., heredity)
- Focus on "universal" (cross-species) properties, e.g. cell division (Images-Of-Images-Of)

5 History of the Genome Concept

Contrast the following two defitions of the term "genome":

- Darlington and Mather 1949: "Chromosome Set, especially as considered genetically."
- Dawkins 1982: "The entire collection of genes possessed by one organism." (Gene is defined noncommittally as "a unit of heredity".)

1. The original definition and subequent uses identify the "genome" with the "chromosome set" and hence are ultimately grounded empirically in what is known about chromsomes and their dynamics.
2. Later definitions are more functional in nature. Either referring to "genes", which are not defined physically (Dawkins, 1982) or to the DNA sequence (e.g., the Genome Project).
3. With these definitions the genome-as-system implicit in previous definitions disappears. Genotype and Genome become to a large extent synonymous.
4. Hence a "new" concept, chromatin, is needed for the physical/mechanistic aspects of the hereditary material.
5. The current genome concept lacks any principled definition. It is *defined* by the technology (e.g. the inclusion of non-coding sequences).

6 Typology of Concepts

(1) **Empirical "entity"** (e.g., "chromosome" in Flemming), (2) **Empirical concept** (e.g., first definitions of genome), (3) **Theoretical/logical concept** (e.g., later definitions),
(4) **Theoretical entity** (when reified).