

Models and Modeling in Science

HPS 38285 Thursday 2:00P- 4:25P CL G28

Sandra Mitchell
CL 1017
412-624-5878
smitchel@pitt.edu

Daniela Bailer-Jones
CL 817E
412-624-0903
dmb32+@pitt.edu

August 28 – Introduction to models

Reading: Rosenblueth, A., & Wiener, N. (1945). The role of models in science. Philosophy of Science, 12, 316-321.

Bailer-Jones, D. M. 2002. Scientists' thoughts on scientific models, *Perspectives on Science*, 10, pp. 275-301.

September 4 - Mechanical/physical models – 19th century background

Reading: Ch. 2 of Bailer-Jones, *Scientific Models*

Boltzmann, L. [1902]1911. Model, *Encyclopaedia Britannica*, 11th ed., Vol. 18, Cambridge: Cambridge University Press, pp. 638-640.

Sterrett, S. "Physical Models and Fundamental Laws: Using one Piece of the World to Tell About Another," *Mind and Society* 2002-2 (forthcoming, 2003);

Further reading:

Duhem, P. [1914]1954. *The Aim and Structure of Physical Theory*, translated from the French 2nd edition, Princeton, New Jersey: Princeton University Press. Chapter 4: Abstract Theories and Mechanical Models

September 11 Analogy: conceptual models and the cognitive story

Reading:

Maxwell, J. C. [1870]1890. Address to the Mathematical and Physical Sections of the British Association, in: W. D. Niven (ed.), *The Scientific Papers of James Clerk Maxwell, Vol. I*, Cambridge: Cambridge University Press, pp. **-**.

Gentner, D. 1983. Structure mapping: A theoretical framework for analogy. *Cognitive Science* 7, pp. 155-170.

Nersessian, N. J. 2002. Maxwell and "the Method of Physical Analogy": Model-based reasoning, generic abstraction, and conceptual change, in: Malamant, D. (ed.), *Essays in the History and Philosophy of Science and Mathematics*,. Lasalle, IL: Open Court, pp. 129-166.

(downloadable from her website)

Further reading:

Ch. 3 of Bailer-Jones, *Scientific Models* (and references there)

September 18 Metaphor and conceptual change

Reading:

Hesse, M. 1966. The explanatory function of metaphor, Chapter in: *Models and Analogies in Science*, Notre Dame: University of Notre Dame Press.

Jordi Cat, On Understanding: Maxwell on the Methods of Illustration and Scientific Metaphor, *Studies in History and Philosophy of Science Part B: Studies in History and Philosophy of Modern Physics* 32 (3) (2001) pp. 395-441.

Further reading:

Bailer-Jones, D. M. 2002. Models, Metaphors and Analogies, in P. Machamer and M. Silberstein (eds.), *Blackwell Guide to Philosophy of Science*, Oxford: Blackwell, pp. 108-127.

Bailer-Jones, D. M. 2000. Scientific Models as Metaphors, in: F. Hallyn (ed.), *Metaphor and Analogy in the Sciences*, Dordrecht: Kluwer Academic Publishers, pp. 181-198.

September 25 Analogy– the logical story

Reading: Weitzenfeld, Julian S. 1984 “Valid Reasoning by Analogy” *Philosophy of Science* 51: 137-149.

Shelley, C. 2002. Analogy counterarguments and the acceptability of analogical hypotheses, *British Journal for the Philosophy of Science* 53, pp. 477-496.

Further reading:

Hesse, M. B. 1966. Material analogy & The Logic of analogy & Aristotle’s logic of analogy, Chapters in: *Models and Analogies in Science*, Notre Dame: University of Notre Dame Press.

October 2. Idealization/abstraction

Reading: Cartwright. *Natures Capacities*, Chapter 5, Abstract and Concrete, pp. 183-230.

McMullin, E. (1985) "Galilean Idealization", *Studies in History and Philosophy of Science*, 16, pp. 247-273.

Further reading:

Mitchell “ Integrative Pluralism” *Biology and Philosophy*, 17, January 2002, pp. 55-70.

Suárez, M. 1999. The role of models in the application of scientific theories: epistemological implications, in: M. Morgan and M. Morrison (eds.), *Models as Mediators*. Cambridge: Cambridge University Press, pp. 168-196.

October 9 *How theories and models relate*

Reading: Suppes, P. 1961. A comparison of the meaning and uses of models in mathematics and the empirical sciences, in: Freudenthal, H. (ed.), *The Concept and the Role of the Models in Mathematics and Natural and Social Sciences*, Dordrecht: D. Reidel Publishing Company), pp. 163-177.

Chakravartty, A. 2001. The semantic or model-theoretic view of theories and scientific realism, *Synthese* 127, pp. 325-345.

Van Fraassen “To Save the Phenomena”, *The Scientific Image*, pp. 41-69.

Further reading:

Ch. 6 in Bailer-Jones, *Scientific Models*

Suppe, F. 1974. The search for philosophic understanding of scientific theories, in Suppe, F. (ed.), *The Structure of Scientific Theories*, Urbana: University of Illinois Press, pp. 3-241.

October 16 *Mathematical Models in Physics*

Reading: Ruetsche “A Matter of Degree: Putting Unitary Inequivalence to Work” *forthcoming Philosophy of Science* 2002.

Roger Jones “Realism about What?” *Philosophy of Science*, Vol. 58, No. 2. (Jun., 1991), pp. 185-202. URL:<http://links.jstor.org/sici?sici=0031-8248%28199106%2958%3A2%3C185%3ARAW%3E2.0.CO%3B2-C>

Possibly another reading by Van Fraassen or Ladyman, to be announced.

October 23 *Relations of models to theories: mediators*

Reading:

Morrison, M. C. 1999. Models as Autonomous Agents, in: M. Morgan and M. Morrison (eds.), *Models as Mediators*. Cambridge: Cambridge University Press, pp. 38-65.

Morrison, M. C., and Morgan, M. S. 1999. Models as mediating instruments, in: M. Morgan and M. Morrison (eds.), *Models as Mediators*. Cambridge: Cambridge University Press, pp. 10-37.

Morton, A. 1993. Mathematical models: Questions of trustworthiness, *British Journal for the Philosophy of Science* 44, pp. 659-674.

October 30: *Asymptotics and truth.*

Reading:

Wimsatt, W. C., 1987. False Models as means to Truer Theories. In: M. Nitecki and A. Hoffman, eds., *Neutral Models in Biology*. London: Oxford University Press, pp. 23-55.

Batterman "Asymptotics and the Role of Minimal Models," *The British Journal for the Philosophy of Science*, Vol. 53, No. 1, 2002, pp. 21-38

November 6 *Simulation Modeling*

Reading:

Eric Winsberg 1999 Sanctioning Models: The Epistemology of Simulation
Science in Context, 12, 275-292.

Fox Keller "Model simulation and "computer experiments"" in Hans Radder (ed) *The philosophy of experimentation*, University of Pittsburgh Press 2003, pp. 198-215

November 13 *Representation*

Reading:

Hughes, R. I. G. 1997. Models and Representation, in: L. Darden (ed.), *PSA 1996, Philosophy of Science* 64 (Proceedings), pp. S325-S336.

Suárez, M. 1999. Theories, Models, and Representations, in L. Magnani, N. Nersessian, and P. Thagard (eds.), *Model-Based Reasoning in Scientific Discovery*. New York: Plenum Publishers, pp. 75-83.

Giere, R. 1999. Using Models to Represent Reality, in: L. Magnani, N. Nersessian and P. Thagard (eds.), *Model-Based Reasoning in Scientific Discovery*. Plenum Publishers: New York, pp. 41-57.

November 20 *Representation II*

Reading:

Bailer-Jones, D. M. 2003a. When Scientific Models Represent, *International Studies in the Philosophy of Science* 17, pp. 59-74.

Suárez, M. 2003. An inferential conception of scientific representation, *PSA2002*

Further reading:

2nd session on recent PSA papers

Ch. 8 of Bailer-Jones, *Scientific Models* and references therein

November 27 – Thanksgiving

December 4 *Models in biology: model organisms*

Readings:

Rachel A. Ankeny: 'Model Organisms as Cases: Understanding the 'Lingua Franca' at the Heart of the Human Genome Project', *Philosophy of Science* 69(Proc.), 2001.

Rachel A. Ankeny "Fashioning Descriptive Models in Biology: Of Worms and Wiring Diagrams", *Philosophy of Science* 67(Proc.): S260-S272, 2000.

LaFollette and Shanks (1995) "Two Models of Models in biomedical research"
Phil quarterly 45:41-160

December 11 **Visual Representation**

On this day – everyone will read a **different** paper, then we will all give short presentations on the paper discussing its theses by means of a visual representation.

Giere, R. 1996. Visual models and scientific judgment, in: B. S. Baigrie (ed.), *Picturing Knowledge: Historical and Philosophical Problems Concerning the Use of Art in Science*, Toronto: Toronto University Press, pp. 269-302.

Woody, A. 2000. Putting quantum mechanics to work in chemistry

Ruse, M. (1991). Are pictures really necessary? The case of Sewell Wright's "adaptive landscapes". In A. Fine, M. Forbes, & L. Wessels (Eds.), *PSA 1990*, Vol. 2. East Lansing, Michigan: Philosophy of Science Association, pp. 63-77.

Wimsatt, W. C. (1991). Taming the dimensions-visualizations in science. In A. Fine, M. Forbes & L. Wessels (Eds.), *PSA 1990*. East Lansing, Michigan: Philosophy of Science Association, pp. 111-135.

Bailer-Jones, D. M. (2002), Sketches as Mental Reifications of Theoretical Scientific Treatment, in M. Anderson, B. Meyer and P. Olivier (eds.), *Diagrammatic Representation and Reasoning*, London: Springer-Verlag, pp. 65-83.

Sargeant, P. (1998), Visual Prototypes, presented at PSA 1998.

Requirements: Students taking seminar for credit must give at least one class presentation and either 1) write a term paper (15-20 pages long) or 2) write 5, three-page papers on the readings. You can reduce the number of short papers you write to 4 by giving 2 class presentations. The short papers should take some claim of the papers we are reading and defend it against objections, apply it to new examples to support it, or criticize it.