Category theory in philosophy of mathematics and philosophy of science

Hans Halvorson

March 10, 2011

An updated version with links will be available at: www.princeton.edu/~hhalvors/teaching/phi536_s2011/reading-list.pdf

1 Does category theory break set theory?

- A. Blass. The interaction between category theory and set theory. *Contemporary Mathematics*, 30:5–29, 1984. www.math.lsa.umich.edu/~ablass/interact.pdf
- S. Feferman. Categorical foundations and foundations of category theory. *Logic, Foundations of Mathematics and Computability Theory*, 1:149–169, 1977. math.stanford.edu/~feferman/papers/Cat_founds.pdf
- S. Feferman and G. Kreisel. Set-theoretical foundations of category theory. In *Reports of the Midwest Category Seminar III (Lecture Notes in Mathematics 161)*, pages 201–247. 1969. dx.doi.org/10.1007/BFb0059148
- A. Grothendieck et al. "Univers" in Exposé I (Prefaisceaux) of SGA4. dx.doi.org/10.1007/BFb0081551
- S. Mac Lane. Foundations for categories and sets. *Category Theory, Homology Theory and their Applications. II. (Lecture Notes in Mathematics 92)*, 92:146–164, 1969. dx.doi.org/10.1007/BFb0080770
- S. Mac Lane. One universe as a foundation for category theory. In *Reports of the Midwest Category Seminar III (Lecture Notes in Mathematics 161)*, pages 192–200. 1969. dx.doi.org/10.1007/BFb0059147
- S. Mac Lane. Categorical algebra and set-theoretic foundations. In *Axiomatic set theory*, pages 231–240. 1971. www.princeton.edu/~hhalvors/teaching/phi536_s2011/maclane1971.pdf

- F. Muller. Sets, classes and categories. *British Journal for the Philosophy of Science.* 52, pages 539–573. 2001. dx.doi.org/10.1093/bjps/52.3.539
- V. Rao. On doing category theory within set theoretic foundations. In *What is category theory*, pages 275–290. 2006.
- M.A. Shulman. Set theory for category theory. Arxiv preprint arXiv:0810.1279, 2008.

2 Does category theory provide an alternative foundation of mathematics?

- J.L. Bell. Category theory and the foundations of mathematics. *British Journal for the Philosophy of Science*, 32(4):349–358, 1981. www.jstor.org/stable/687305
- G. Blanc and A. Preller. Lawvere's basic theory of the category of categories. *The Journal of Symbolic Logic* 40(1), pages 14–18. 1975. www.jstor.org/stable/2272263
- G. Blanc and M.R. Donnadieu. Axiomatisation de la catégorie des catégories. *Cahiers Topologie Géom. Différentielle* 17(2), pages 135–170. 1976. www.numdam.org/item?id=CTGDC_1976__17_2_135_0
- P. Dedecker. Category theory and the foundations of mathematics. In *Mathematical logic and formal systems : a collection of papers in honor of Professor Newton C.A. da Costa*. pages 67–84.
- G. Kreisel. Appendix II. Category theory and the foundations of mathematics. In *Reports of the Midwest Category Seminar. III* (LNM 106), pages 233–247.
- F.W. Lawvere. The category of categories as a foundation for mathematics. In *Proceedings of the Conference on Categorical Algebra*. pages 1–20. Springer, 1966. See also Math Review # MR0207517 (34 #7332) by J.R. Isbell. www.princeton.edu/~hhalvors/lawvere1965.pdf
- Ø. Linnebo and R. Pettigrew. Only up to isomorphism? Category theory and the foundations of mathematics. 2010. seis.bris.ac.uk/~rp3959/papers/onlyuptoiso.pdf
- M. Makkai. Towards a categorical foundation of mathematics. In *Logic Colloquium*, volume 95, pages 153–190. 1998. projecteuclid.org/euclid.lnl/1235415906
- J. Mayberry. What is required of a foundation for mathematics?. *Philosophia Mathematica*, (3), Volume 2, Special Issue, "Categories in the Foundations of Mathematics and Language", pages 16–35. 1994.
- C. McLarty. Axiomatizing a category of categories. *The Journal of Symbolic Logic* 56(4), pages 1243–1260. 1991. www.jstor.org/stable/2275472

3 Does category theory help structuralism?

- S. Awodey. Structure in mathematics and logic: A categorical perspective. *Philosophia Mathematica*, 4(3):209, 1996.
- S. Awodey. An answer to Hellman's question: does category theory provide a framework for mathematical structuralism? *Philosophia Mathematica* 54–64, 2004. `philmat.oxfordjournals.org/cgi/reprint/12/1/54.pdf`
- J. Bain. Category-theoretic structure and radical ontic structural realism. `ls.poly.edu/~jbain/papers/CatTheoROSR.pdf`
- J.P. Burgess. Putting structuralism in its place. `www.princeton.edu/~jburgess/Structuralism.pdf`
- J.C. Cole. Mathematical structuralism today. *Philosophy Compass*, 5(8):689–699, 2010.
- L. Corry. Nicholas Bourbaki and the concept of mathematical structure. *Synthese*, 92(3): 315–348, 1992. `dx.doi.org/10.1007/BF00414286`
- J. Couture and J. Lambek. Philosophical reflections on the foundations of mathematics. *Erkenntnis*, 34(2):187–209, 1991.
- G. Hellman. Does category theory provide a framework for mathematical structuralism? *Philosophia Mathematica* 11(2), pages 129–157. 2003. `dx.doi.org/10.1093/philmat/11.2.129`
- G. Hellman. Three varieties of mathematical structuralism. *Philosophia Mathematica*, 9(2):184, 2001.
- G. Hellman. Structuralism. *The Oxford handbook of philosophy of mathematics and logic*, 1(9):536–563, 2005.
- G. Hellman. What is categorical structuralism? *The Age of Alternative Logics*, pages 151–161, 2006.
- E. Landry. Category theory as a framework for an *in re* interpretation of mathematical structuralism. *The Age of Alternative Logics*, pages 163–179, 2006.
- E. Landry. Reconstructing Hilbert to construct category theoretic structuralism. 2009.
- H. Leitgeb and J. Ladyman. Criteria of identity and structuralist ontology. *Philosophia Mathematica*, 2007.
- S. Mac Lane. Structure in mathematics. *Philosophia Mathematica*, 4(2):174, 1996.

- M. Makkai. On structuralism in mathematics. In *Language, Logic, and Concepts*, pages 43–66. cognet.mit.edu/library/books/chapter?isbn=0262600463&part=chap3

- C. McLarty. Exploring categorical structuralism. *Philosophia Mathematica*, 12(1):37, 2004.

- C. McLarty. What structuralism achieves. *The Philosophy of Mathematical Practice*, 1(9):354–370, 2008.

- E. Palmgren. Category theory and structuralism. 2009. www2.math.uu.se/~palmgren/CTS-fulltext.pdf

- M. Pedroso. On three arguments against categorical structuralism. *Synthese*, 170(1):21–31, 2009. dx.doi.org/10.1007/s11229-008-9346-2

- S. Shapiro. Mathematical structuralism. *Philosophia Mathematica*, 4(2):81, 1996.

- S. Shapiro. Categories, structures, and the Frege-Hilbert controversy: The status of meta-mathematics. *Philosophia Mathematica*, 13(1):61, 2005.

4 Miscellaneous

- S. Awodey. From sets, to types, to categories, to sets. www.andrew.cmu.edu/user/awodey/preprints/stcsFinal.pdf

- J.L. Bell. From absolute to local mathematics. *Synthese* 69(3), pages 409–426. 1986. dx.doi.org/10.1007/BF00413980

- J. Bénabou. Fibered categories and the foundations of naive category theory. *Journal of Symbolic Logic* 50(1), pages 10–37. 1985. www.jstor.org/stable/2273784. See also T. Streicher, Fibred categories à la Bénabou. www.mathematik.tu-darmstadt.de/~streicher/FIBR/FibLec.pdf.gz

- A. Blass. Why sets? *Pillars of computer science*, pages 179–198, 2008. dx.doi.org/10.1007/978-3-540-78127-1_11

- E. Engeler and H. Röhrl. On the problem of foundations of category theory. *Dialectica* 23(1), pages 58-66. 1969. dx.doi.org/10.1111/j.1746-8361.1969.tb01179.x

- S. Feferman. Enriched Stratified systems for the foundations of category theory. in *What is Category Theory?* (G. Sica, ed.) Polimetrica. pages 195–203. 2006.
  math.stanford.edu/~feferman/papers/ess.pdf

- G. Kreisel. Observations of popular discussions on foundations. In *Axiomatic set theory*. American Mathematical Society. pages 183–190. 1971.

- J. Lambek and P. Scott. Reflections on a categorical foundations of mathematics. www.site.uottawa.ca/~phil/papers/LS11.final.pdf

- E. Landry. Category theory: the language of mathematics. *Philosophy of Science* 66(3), pages 14–27. 1999.

- E. Landry and J.-P. Marquis. Categories in context: historical, foundational and philosophical. *Philosophia Mathematica* 13(1), pages 1–43. 2005. dx.doi.org/10.1093/philmat/nki005

- S. Mac Lane. Mathematical models: A sketch for the philosophy of mathematics. *American Mathematical Monthly*, 88(7):462–472, 1981.

- J.P. Marquis. Category theory and the foundations of mathematics: philosophical excavations. *Synthese*, 103(3):421–447, 1995. springerlink.com/index/LNL7084Q448756Q6.pdf

- J.P. Marquis. Categories, sets and the nature of mathematical entities. *The Age of Alternative Logics*, pages 181–192, 2006.

- C. McLarty. Learning from questions on categorical foundations. *Philosophia Mathematica*, 13(1):44, 2005.

- C. McLarty What does it take to prove Fermat's last theorem?. *Bulletin of Symbolic Logic*, 16 pages 359–377. 2010. jstor.org/stable/20749620

- C. McLarty. Weak set theory for Grothendieck's number theory. arxiv.org/abs/1102.1773

- I. Moerdijk. Sets, topoi and intuitionism. *Philosophia Mathematica*, 6(2):169, 1998.

- N.H. Williams. On Grothendieck universes. *Compositio Mathematica*, 21(1): pages 1–3. 1969. archive.numdam.org/article/CM_1969__21_1_1_0.pdf

- Numerous articles in *Foundational Theories of Classical and Constructive Mathematics*, forthcoming March 2011 from Springer. ISBN 9789400704305