Reading list for Advanced Philosophy of Physics: the philosophy of statistical mechanics

(revised David Wallace, February 2010[1])

This is a reasonably thorough reading list for the philosophy of statistical mechanics: it generally contains more material on each topic than is practical for a weekly tutorial, but it may serve as a starting point for constructing tutorial reading lists, as a source for further reading or revision, and as inspiration, starting point or reference for extended essays and theses.

The philosophy of statistical mechanics is a very chaotic discipline – much more so than, for instance, philosophy of quantum mechanics. As such, even working out how to organise the material is a non-trivial philosophical activity, and my own way of organising it doubtless betrays various philosophical prejudices. (One prejudice that I'm aware of: the list errs towards a non-historical approach. The review article by Uffink, below, is a good starting point for those who want to engage with the historical development of the subject.)

Whenever I put more than a few readings, I have picked out a few "starting points" or "core readings" with asterisks. Again, there is some subjectivity in the choice, no doubt.

I have put electronic links, where possible, for any reference which is not in a standard academic journal. Most journals should already be available online via SOLO.

General textbooks and review articles

Some recent, accessible philosophical introductions

Albert, D. Z. (2000), *Time and Chance*, Harvard University Press, Cambridge, MA.
(introductory, but not at all neutral – Albert has a very strong line on the problem. The style is unusual – people either like it or hate it.)[2]

Sklar, L. (1993), Physics and Chance: Philosophical Issues in the Foundations of Statistical Mechanics, Cambridge University Press, Cambridge.
(The anti-Albert, in a way – very scholarly, very even-handed, sometimes it can be difficult to see the wood for the trees)[3]

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[1] Suggestions from Simon Saunders, Hilary Greaves, Chris Timpson and Charlotte Werndl gratefully acknowledged.

[2] For a – fairly critical – review, see J. Uffink, *Studies in the History and Philosophy of Modern Physics* 33 (2002) , pp. 555-563.

[3] For reviews, see T. Maudlin, *British Journal for the Philosophy of Science* 46 (1995), pp. 145-149, and J. Uffink, *Studies in the History and Philosophy of Modern Physics* 27 (1996), pp. 378-381

Frigg, R. (2007), A Field Guide to Recent Work on the Foundations of Thermodynamics and Statistical Mechanics, *in* Dean Rickles, ed.,'The Ashgate Companion to the New Philosophy of Physics', Ashgate, London, pp. 99--196.
(Very recent review article – does a pretty good job of surveying the terrain)

Uffink, J. (2007), Compendium of the foundations of classical statistical physics, *in* J. Butterfield & J. Earman, ed.,'Handbook for Philosophy of Physics', Elsevier. Available online at http://philsci-archive.pitt.edu/archive/00002691/
(Extremely thorough, somewhat historically oriented review; longer and more technically demanding than Frigg's review)

General discussions from a more physics-oriented viewpoint

Schulman, L. S. (1997), *Time's Arrows and Quantum Measurement*, Cambridge University Press, Cambridge.
(Fairly technical; largely concerned with quantum mechanics, not statistical mechanics)

Davies, P. C. W. (1974), *The Physics of Time Asymmetry*, University of California Press, Berkeley.
(Somewhat less technical than Schulman)

Penrose, O. (1979), 'Foundations of Statistical Mechanics', *Reports on Progress in Physics* **42**, 1937--2006.
(Technically oriented, detailed survey article by one of the leading practitioners. (NB: this is not Roger Penrose; it's Oliver Penrose, his brother.)

Classic texts, still relevant

Ehrenfest, P. & Ehrenfest, T. (1959), *The Conceptual Foundations of the Statistical Approach in Mechanics*, Cornell University Press, Ithaca, NY.

Gibbs, J. (1960), *Elementary Principles in Statistical Mechanics*. Dover, New York.

More general books on statistical mechanics and thermodynamics

There are literally hundreds of textbooks on statistical mechanics and equilibrium thermodynamics; trying to survey the field seems pointless, and everyone has their own favourites. It is important, though, for students of the field to make sure they've studied from or at least looked at mainstream physics accounts of statistical mechanics, and not just the foundational versions – otherwise it can be easy to forget just how predictively powerful statistical mechanics can be, despite its foundational perplexities.

The direction of time in thermodynamics, and the Second Law

(*)Albert, D. Z. (2000), *Time and Chance*, Harvard University Press, Cambridge, MA. Read chapter 2.

(*)Brown, H. R. & Uffink, J. (2001), 'The Origins of Time-Asymmetry in Thermodynamics: The Minus First Law', *Studies in the History and Philosophy of Modern Physics* **32**, 525--538. Esp. sections 1-3.

Eddington, A. (1928), *The Nature of the Physical World*, Everyman's Library, London. Chapter IV, esp. "Thermodynamical equilibrium", pp. 77-80.

(*)Feynman, R. (1967), *The Character of Physical Law,* MIT Press, Cambridge, MA. Read the chapter entitled "The Distinction of Past and Future".

Davies, P. C. W. (1974), *The Physics of Time Asymmetry*, University of California Press, Berkeley. Read section 2.1

Uffink, J. (2001), 'Bluff Your Way in the Second Law of Thermodynamics', *Studies in the History and Philosophy of Modern Physics* **32**, 305-394.

Boltzmann's H-theorem, and the reversibility and recurrence objections

(NB: many of the issues with the H theorem can also be understood from the perspective of the simpler wind-tree model or the Kac ring model; see references below.

Bricmont, J. (1995), 'Science of Chaos or Chaos of Science?', *Physicalia* **17**,159-208; available online at http://dogma.free.fr/txt/JB-Chaos.htm. Appendix I (for the Kac ring model).

(*)Brown, H. R.; Myrvold, W. & Uffink, J. (2009), 'Boltzmann's H-theorem, its discontents, and the birth of statistical mechanics', *Studies in History and Philosophy of Modern Physics* **40**, 174--191.

Davies, P. C. W. (1974), *The Physics of Time Asymmetry*, University of California Press, Berkeley. Sections 3.1 and 3.2.

Ehrenfest, P. & Ehrenfest, T. (1959), *The Conceptual Foundations of the Statistical Approach in Mechanics*, Cornell University Press, Ithaca, NY. Section I (pp. 4-16) and section II (pp. 17-41), esp. sections 5, 6, 7, 14. Section 5 gives an account of the wind tree model.

Schulman, L. S. (1997), *Time's Arrows and Quantum Measurement*, Cambridge University Press, Cambridge. Section 2.1 (for the Kac ring model) and pp. 27-9.

(*)Sklar, L. (1993), *Physics and Chance: Philosophical Issues in the Foundations of Statistical Mechanics*, Cambridge University Press, Cambridge. pp. 60-67.

(*)Uffink, J. (2007), Compendium of the foundations of classical statistical physics, *in* J. Butterfield & J. Earman, ed.,'Handbook for Philosophy of Physics', Elsevier. Available online at http://philsci-archive.pitt.edu/archive/00002691/. Sections 4.2-4.5

Ergodicity and Gibbs' characterization of equilibrium

(*)Albert, D. Z. (2000), *Time and Chance*, Harvard University Press, Cambridge, MA. Chapter 3.

(*)Callendar, C. (1999) "Reducing Thermodynamics to Statistical Mechanics: the Case of

Entropy". *Journal of Philosophy* 96, pp. 348-373.

Callender, C. (2002), 'Taking Thermodynamics Too Seriously', *Studies in the History and Philosophy of Modern Physics* **32**, 439--553. Sections 1-3.

(*)Earman, J. & Redei, M. (1996), 'Why Ergodic Theory Does Not Explain the Success of Equilibrium Statistical Mechanics', *British Journal for the Philosophy of Science* **47**, 63--78.

Friedman, K. S. "A partial vindication of ergodic theory", *Philosophy of Science* 43 (1976), pp. 151-162.

Frigg, R. (2007), A Field Guide to Recent Work on the Foundations of Thermodynamics and Statistical Mechanics, *in* Dean Rickles, ed.,'The Ashgate Companion to the New Philosophy of Physics', Ashgate, London. pp. 141-151.

Jaynes, E. T. "Gibbs vs. Boltzmann Entropies", *American Journal of Physics* 33 (1965), pp. 391-398.

Lavis, D. (2005). 'Boltzmann and Gibbs: an Attempted Reconciliation', *Philosophy of Science* **36**, 245-273.

Lavis, D. (2008), 'Boltzmann, Gibbs, and the Concept of Equilibrium', *Philosophy of Science* **75**, 682--696.

Leeds, S. (1989), 'Malament and Zabell on Gibbs Phase Averaging', *Philosophy of Science* **56**, 325--340.

(*)Malament, D. & Zabell, S. L. (1980), 'Why Gibbs Phase Space Averages Work: the Role of Ergodic Theory', *Philosophy of Science* **47**, 339--349.

(*)Maudlin, T. (1995) "Review [of Sklar, *ibid*]"*, British Journal for the Philosophy of Science* 46, 145-149*.

(*)Sklar, L. (1993), *Physics and Chance: Philosophical Issues in the Foundations of Statistical Mechanics*, Cambridge University Press, Cambridge. pp. 41-50, 71-87, 159-162, 164-188, 190-194 (for Jaynes' approach), 233, 236

(*)Uffink, J. (1996), "Nought but Molecules in Motion" (review of Sklar, *ibid*). *Studies in the History and Philosophy of Modern Physics* 27, pp. 378-381

Uffink, J. (2007), Compendium of the foundations of classical statistical physics, *in* J. Butterfield & J. Earman, ed.,'Handbook for Philosophy of Physics', Elsevier. Available online at http://philsci-archive.pitt.edu/archive/00002691/. Sections 5, 6.1

van Lith, J. (1999), 'Reconsidering the Concept of Equilibrium in Classical Statistical Mechanics', *Philosophy of Science* **66**, S107--S118.

van Lith, J. (2002), 'Ergodic Theory, Interpretations of Probability and the Foundations of Statistical Mechanics', *Studies in the History and Philosophy of Modern Physics* **32**, 581--594.

Vranas, P. B. M. (1998), 'Epsilon-Ergodicity and the Success of Equilibrium Statistical Mechanics', *Philosophy of Science* **65**, 688--708.

Coarse-graining and the approach to equilibrium

The general issue

(*)Albert, D. Z. (2000), *Time and Chance*, Harvard University Press, Cambridge, MA. Chapter 4, esp. pp. 85-91

Berkovitz, J.; Frigg, R. & Kronz, F. (2006), 'The ergodic hierarchy, randomness and Hamiltonian chaos', *Studies in History and Philosophy of Modern Physics* **37**(4), 661--691.

Frigg, R. (2007), A Field Guide to Recent Work on the Foundations of Thermodynamics and Statistical Mechanics, *in* Dean Rickles, ed.,'The Ashgate Companion to the New Philosophy of Physics', Ashgate, London. pp. 155-164.

North, J. (2002), 'What is the problem about the time-asymmetry of thermodynamics? - a reply to Price', *British Journal for the Philosophy of Science* **53**, 121--136.

(*)Maudlin, T. (1995) "Review [of Sklar, *ibid*]"*, British Journal for the Philosophy of Science* 46, 145-149.

(*)Ridderbos, K. (2002), 'The coarse-graining approach to statistical mechanics: how blissful is our ignorance?', *Studies in the History and Philosophy of Modern Physics* **33**, 65--77.

(*)Ridderbos, T. M. & Redhead, M. L. G. (1998), 'The Spin-Echo Experiments and the Second Law of Thermodynamics', *Foundations of Physics* **28**, 1237--1270.

(*)Sklar, L. (1993), *Physics and Chance: Philosophical Issues in the Foundations of Statistical Mechanics*, Cambridge University Press, Cambridge. chapter 6 (for the formal ideas); chapter 7, esp. pp.219-224, 246-250, 260-262) for conceptual discussion

Uffink, J. (1996), "Nought but Molecules in Motion" (review of Sklar, *ibid*). *Studies in the History and Philosophy of Modern Physics* 27, pp. 378-383

Uffink, J. (2007), Compendium of the foundations of classical statistical physics, *in* J. Butterfield & J. Earman, ed.,'Handbook for Philosophy of Physics', Elsevier. Available online at http://philsci-archive.pitt.edu/archive/00002691/. Section 7.

Wallace, D. (2009), "The logic of the past hypothesis", available online at users.ox.ac.uk/~mert0130

Werndl, C. (2009). Are Deterministic Descriptions and Indeterministic Descriptions Observationally Equivalent? *Studies in History and Philosophy of Modern Physics* 40, 232-242

The interventionist strategy

Blatt, J.M. (1959), "An Alternative Approach to the Ergodic Problem", Progress of Theoretical Physics 22(6), 745-756. (The original text where the idea was introduced)

Davies, P. C. W. (1974), *The Physics of Time Asymmetry*, University of California Press, Berkeley. Section 3.5

Frigg, R. (2007), A Field Guide to Recent Work on the Foundations of Thermodynamics and Statistical Mechanics, *in* Dean Rickles, ed.,'The Ashgate Companion to the New Philosophy of Physics', Ashgate, London. pp. 164-166.

Penrose, O. (1979), 'Foundations of Statistical Mechanics', *Reports on Progress in Physics* **42**, 1937--2006. Section 3.6

(*)Ridderbos, T. M. & Redhead, M. L. G. (1998), 'The Spin-Echo Experiments and the Second Law of Thermodynamics', *Foundations of Physics* **28**, 1237--1270.

(*) Shenker, O. (2001), 'Interventionism in Statistical Mechanics: Some Philosophical Remarks', Available online at philsci-archive.pitt.edu/archive/00000151.

(*) Sklar, L. (1993), *Physics and Chance: Philosophical Issues in the Foundations of Statistical Mechanics*, Cambridge University Press, Cambridge, pp. 250-255.

The Brussels-Austin school

Batterman, R. (1991). Randomness and Probability in Dynamical Theories: On the Proposals of the Prigogine School. *Philosophy of Science* **58**, 241-263.

Bishop, R. C. (2004), 'Nonequilibrium statistical mechanics Brussels–Austin style', *Studies in the History and Philosophy of Modern Physics* **35**, 1-30.

Frigg, R. (2007), A Field Guide to Recent Work on the Foundations of Thermodynamics and Statistical Mechanics, *in* Dean Rickles, ed.,'The Ashgate Companion to the New Philosophy of Physics', Ashgate, London. pp. 167-8.

Karakostas, V. (1996), 'On the Brussels School's Arrow of Time in Quantum Theory', *Philosophy of Science* **63**, 374-400.

Sklar, L. (1993), *Physics and Chance: Philosophical Issues in the Foundations of Statistical Mechanics*, Cambridge University Press, Cambridge, pp. 246-250, 269-276.

Jaynes' objective-Bayesianism approach

Baierlein, R. (1971), *Atoms and Information Theory: an Introduction to Statistical Mechanics*, W. H. Freeman, San Fransisco. (Actually a textbook, from a Jaynesian

viewpoint; only read the foundational parts.)

Balian, R. (2005), 'Information in statistical physics', *Studies in the History and Philosophy of Modern Physics* **36**, 323--353.

(*) Friedman, K. and Shimony, A. (1971) 'Jaynes' Maximum Entropy Prescription and Probability Theory', *Journal of Statistical Physics* 3, pp. 381-4.

Frigg, R. (2007), A Field Guide to Recent Work on the Foundations of Thermodynamics and Statistical Mechanics, *in* Dean Rickles, ed.,'The Ashgate Companion to the New Philosophy of Physics', Ashgate, London. p.168-174.

Jaynes, E. (1957), 'Information Theory and Statistical Mechanics', *Physical Review* **106**, 620.

Jaynes, E. (1957), 'Information Theory and Statistical Mechanics II', *Physical Review* **108**, 171.

(*) Jaynes, E. (1965) "Gibbs vs. Boltzmann Entropies", *American Journal of Physics* 33, pp. 391-398.

(*) Jaynes, E. (1979), "Where do we stand on maximum entropy", in *The Maximum Entropy Formalism,* ed. R.D. Levine and M. Tribus (MIT Press: Cambridge, MA). Reprinted in Jaynes, E. (1983), *Papers on Probability, Statistics, and Statistical Physics* (Dordrecht: Reidel).

(*) Sklar, L. (1993), *Physics and Chance: Philosophical Issues in the Foundations of Statistical Mechanics*, Cambridge University Press, Cambridge, pp. 190-194, 255-260.

(*) Uffink, J. (1997), 'The Constraint Rule of the Maximum Entropy Principle', *Studies in the History and Philosophy of Modern Physics* **27**, 47--79.

Uffink, J. (1995), 'Can the Maximum Entropy Principle be Explained as a Consistency Requirement?', *Studies in the History and Philosophy of Modern Physics* **26**, 223--261.

The (neo)-Boltzmannian approach and the Past Hypothesis

(see also the papers on Gravity, below)

(*) Albert, D. Z. (2000), *Time and Chance*, Harvard University Press, Cambridge, MA. Chapter 4

Callender, C. (2004), There is No Puzzle about the Low-Entropy Past, *in* Christopher Hitchcock, ed.,'Contemporary Debates in the Philosophy of Science', Blackwell, Oxford, pp. 240--257.

Callender, C. (2004), 'Measures, Explanations and the Past: should "special" initial conditions be explained?', *British Journal for the Philosophy of Science* **55**, 195--217.

(*) Earman, J. (2006), 'The `Past Hypothesis': Not even false', *Studies in the History and Philosophy of Modern Physics* **37**, 399--430.

Frigg, R. (2009), Probability in Boltzmannian Statistical Mechanics, *in* Gerhard Ernst & Andreas Huttemann, ed.,'Time, Chance and Reduction: Philosophical Aspects of Statistical Mechanics', Cambridge University Press, Cambridge.

Frigg, R. (2007), A Field Guide to Recent Work on the Foundations of Thermodynamics and Statistical Mechanics, *in* Dean Rickles, ed.,'The Ashgate Companion to the New Philosophy of Physics', Ashgate, London, pp. 103-140, esp. 103-110, 113-114, 119-120, 126-133.

(*) Frigg, R. (2008), 'Typicality and the Approach to Equilibrium in Boltzmannian Statistical Mechanics', Available online at http://philsci-archive.pitt.edu.

(*) Goldstein, S. (2001), Boltzmann's Approach to Statistical Mechanics, *in* J. Bricmont; D. Durr; M. Galavotti; F. Petruccione & N. Zanghi, ed.,'In: Chance in Physics: Foundations and Perspectives', Springer, Berlin, pp. 39.

Parker, D. (2005), 'Thermodynamic Irreversibility: Does the Big Bang Explain What It Purports to Explain?', *Philosophy of Science* **72**(5), 751--763.

Penrose, R. (1989) *The Emperor's New Mind,* Oxford University Press. Chapter 7.

(*) Penrose, R. (1994) "On the Second Law of Thermodynamics". *Journal of Statistical Physics*, Vol. 77, Nos. 1/2

Price, H. (2004), Why there is Still a Puzzle about the Low-Entropy Past, *in* Christopher Hitchcock, ed.,'Contemporary Debates in the Philosophy of Science', Blackwell, Oxford, pp. 219--239.

Price, H (1996). *Time's Arrow and Archimedes' Point*. Oxford University Press. Chapter 2 (pp. 22-48).

(*)Volchan, S. B. (2007), 'Probability as typicality', *Studies in the History and Philosophy of Modern Physics* **38**, 801--814.

Maxwell's Demon and Landauer's Principle

(NB: Leff and Rex (2003) contains an exhaustive bibliography of practically everything ever written on Maxwell's demon)

Albert, D. Z. (2000), *Time and Chance*, Harvard University Press, Cambridge, MA. Chapter 5

Bennett, C. H. (1982), 'The thermodynamics of computation – a review". *International Journal of Theoretical Physics* **21,** 905-940. Reprinted in Leff and Rex (2003).

(*) Bennett, C. H. (2003), 'Notes on Landauer's principle, reversible computation, and

Maxwell's Demon', *Studies in the History and Philosophy of Modern Physics* **34**, 501--510.

Brillouin, L. (1951), "Maxwell's Demon cannot operate: Information and Entropy I". *Journal of Applied Physics* **22**, 334-337. Reprinted in Leff and Rex (2003).

(*) Bub, J. (2002), 'Maxwell's Demon and the Thermodynamics of Computation', *Studies in the History and Philosophy of Modern Physics* **32**, 569--579.

Earman, J. & Norton, J. (1998), 'EXORCIST XIV: The Wrath of Maxwell's Demon. Part I. From Maxwell to Szilard', *Studies in the History and Philosophy of Modern Physics* **29**, 435--471.

Earman, J. & Norton, J. (1999), 'EXORCIST XIV: The Wrath of Maxwell's Demon. Part II. From Szilard to Landauer and Beyond', *Studies in the History and Philosophy of Modern Physics* **30**, 1--40.

Ladyman, J.; Presnell, S.; Short, A. & Groisman, B. (2007), 'The connection between logical and thermodynamic irreversibility', *Studies in History and Philosophy of Modern Physics* **38**(1), 58--79.

(*) Leff and Rex (2003), *Maxwell's Demon 2: Entropy, Classical and Quantum Information, Computing*. Bristol: Institute of Physics Publishing. Contains a good general introduction, and dozens of classic and contemporary papers.

Landauer, R. (1961), 'Irreversibility and Heat Generation in the Computing Process', *IBM Journal of Research and Development* **5**, 183--191. Reprinted in Leff and Rex (2003).

Maroney, O. J. E. (2005), 'The (absence of a) relationship between thermodynamic and logical reversibility', *Studies in the History and Philosophy of Modern Physics* **36**, 355-374.

Maroney, O. (2009), 'Information Processing and Thermodynamic Entropy'. *Stanford Encyclopedia of Philosophy (Fall 2009 edition),* Edward N. Zalta (ed.), available online at plato.stanford.edu/archives/fall2009/entries/information-entropy .

(*) Norton, J. D. (2005), 'Eaters of the lotus: Landauer's principle and the return of Maxwell's demon', *Studies in the History and Philosophy of Modern Physics* **36**, 375--411.

Shenker, O. (1999), 'Maxwell's Demon and Baron Munchausen: Free Will as a Perpetuum Mobile', *Studies in the History and Philosophy of Modern Physics* **30**, 347--372.

Szilard, L. (1964), 'On the decrease of entropy by the intervention of intelligent beings', *Behavioral Sciences* **9**, 301--310. Reprinted in Leff and Rex (2003).

Weinstein, S. (2003), 'Objectivity, Information, and Maxwell's Demon', *Philosophy of*

Science **70**, 1245--1255.

Zurek, W. H. (1999). 'Algorithmic Randomness, Physical Entropy, Measurements, and the Demon of Choice'. In *Feynman and Computation: Exploring the Limits of Computers,* ed. J.H. Hey (Reading: Perseus), 393-410. Reprinted in Leff and Rex (2003).

Identical Particles and the Gibbs Paradox

(*) Albert, D. (2000). *Time and Chance*. Cambridge: Harvard University Press. Chapter 3.

(*) Bach, A. (1997). *Indistinguishable Classical Particles*. Berlin: Springer.Chapter 1

Debs, T., and M. Redhead (2007), *Objectivity, Invariance, and Convention*, Cambridge MA: Harvard University Press.

Dieks, D. (1990). 'Quantum statistics, identical particles and correlations'. *Synthese*, **82**, 127- 55

Ehrenfest, P., and V. Trkal (1920). 'Deduction of the dissociation equilibrium from the theory of quanta and a calculation of the chemical constant based on this.' *Proceedings of the Amsterdam Academy*, **23**, 162-183. Reprinted in P. Bush, (ed.), *P. Ehrenfest, Collected Scientific Papers*. Amsterdam: North-Holland, 1959.

French, S. and D. Krause (2006). *Identity in Physics: a historical, philosophical, and formal analysis*. Oxford: Oxford University Press.

(*) French, S., and M. Redhead (1988). 'Quantum mechanics and the identity of indiscernibles.' *British Journal for the Philosophy of Science* **39**, 233-246.

Gibbs, J. W. (1902). *Elementary Principles in Statistical Mechanics*. New Haven: Yale University Press.

Gottesman, D. (2007). 'Quantum statistics with classical particles', in O. Hirota, J.H. Shapiro, and M. Sasaki (eds.), *Quantum Communication, Measurement and Computing. Proceedings of the 8th international conference on quantum communication, measurement, and computing*. Tokyo: NICT Press.

 (*) Huggett, N. (1999). 'Atomic metaphysics'. *Journal of Philosophy*, **96**, 5-24.

Lieb, E., and J. Yngvason, (1999). 'The physics and mathematics of the second law of thermodynamics'. *Physics Reports*, **310**, 1-96.

MacBride, F. (2006), 'What constutes the numerical diversity of mathematical objects?' *Analysis* **66**, 63-69.

Margenau, H. (1944). 'The exclusion principle and its philosophical importance'. *Philosophy of Science* **11**, 187-208

Muller, F. and S. Saunders (2008), 'Discerning Fermions', *British Journal for the Philosophy of Science*, **59**, 499-548.

Pooley, O. (2006). 'Points, particles, and structural realism'. In D. Rickles, S. French, and J. Saatsi (eds.), *The Structural Foundations of Quantum Gravity*. Oxford: Clarendon Press.

Rosenfeld, L. (1959). 'Max Planck et la definition statistique de l'entropie'. *Max-Planck Festschrift* 1958, Berlin: Deutsche Verlag der Wissenschaften. Trans. as 'Max Planck and the Statistical Definition of Entropy'. In R. Cohen and J. Stachel (eds.), *Selected Papers of Leon Rosenfeld*. Dordrecht: Reidel, 1979.

(*) Saunders, S. (2006), 'Are quantum particles objects?', *Analysis*, **66**, p.52-63.

Saunders, S. (2006). On the explanation for quantum statistics, *Studies in the History and Philosophy of Modern Physics*, **37**, 192-211.

Schrödinger E. (1946). *Statistical Thermodynamics*. Cambridge: Cambridge University Press.

Stern, O. (1949). 'On the term N! in the entropy'. *Reviews of Modern Physics*, **21**, 534-35.

van Fraassen, B. (1991). Ch..11, *Quantum Mechanics: An Empiricist View*. Oxford: Clarendon Press.

 (*) van Kampen, N. (1984). 'The Gibbs paradox'. *Essays in theoretical physics in honour of Dirk ter Haar*, W.E. Parry, (ed.). Oxford: Pergamon Press.

Specialised topics

Gravity and statistical mechanics

Callender, C. (2009), The Past Hypothesis Meets Gravity, *in* Gerhard Ernst & Andreas Hütteman, ed.,'Time, Chance and Reduction: Philosophical Aspects of Statistical Mechanics', Cambridge University Press, Cambridge.

Earman, J. (2006), 'The `Past Hypothesis': Not even false', *Studies in the History and Philosophy of Modern Physics* **37**, 399--430.

(*) Penrose, R. (1989), *The Emperor's New Mind.* Oxford University Press. Chapter 7

(*) Wallace, D. (2010), 'Gravity, entropy, and cosmology: in search of clarity', Forthcoming in *British Journal for the Philosophy of Science*.

The von Neumann entropy and the entropy-entanglement link

Hemmo, M. & Shenker, O. (2006), 'Von Neumann's Entropy Does Not Correspond to Thermodynamic Entropy', *Philosophy of Science* **73**, 2.

Henderson, L. (2003), 'The von Neumann Entropy: a Reply to Shenker', *British Journal for the Philosophy of Science* **54**, 291--296.

(*) Peres, A. (1993), *Quantum Theory: Concepts and Methods.* Kluwer. Chapter 9, sections 1-4.

(*) Popescu, S., Short, A. and Winter, A. (2006), 'Entanglement and the Foundations of Statistical Mechanics', *Nature Physics* **2**, 745—758.

Linden, N., Popescu, S., Short, A. and Winter, A. (2009), 'Quantum Mechanical Evolution Towards Thermal Equilibrium', *Physical Review E* **79**:061103.

Shenker, O. (1999), 'Is -tr(ρ ln ρ) the entropy in quantum mechanics', *British Journal for the Philosophy of Science* **50**, 33--48.

Wehrl (1978), 'General Properties of Entropy', *Reviews of Modern Physics* **50**, 221-260.

Decoherence and the approach to equilibrium

Hemmo, M. & Shenker, O. (2003), 'Quantum Decoherence and the Approach to Equilibrium', *Philosophy of Science* **70**, 330—358

Hemmo, M. & Shenker, O. (2005), 'Quantum decoherence and the approach to equilibrium(II)', *Studies in the History and Philosophy of Modern Physics* **36**, 626--648.

Wallace, D. (2001), 'Implications of quantum mechanics in the foundations of statistical mechanics', available online at users.ox.ac.uk/~mert0130

The GRW theory and the approach to equilibrium

Albert, D. Z. (2000), *Time and Chance*, Harvard University Press, Cambridge, MA. Chapter 7

Hemmo, M. & Shenker, O. (2002), 'Can We Explain Thermodynamics By Quantum Decoherence?', *Studies in the History and Philosophy of Modern Physics* **32**, 555--568.

The thermodynamic limit

Batterman, R. (1998).Why Equilibrium Statistical Mechanics Works: Universality and the Renormalization Group. *Philosophy of Science* **65**, 183-208.

Callender, C. (2002), 'Taking Thermodynamics Too Seriously', *Studies in the History and Philosophy of Modern Physics* **32**, 439--553.

Liu, C. (2001), 'Infinite Systems in SM Explanations: Thermodynamic Limit, Renormalization (semi-) Groups, and Irreversibility', *Philosophy of Science* **68**, S325--S344.

The nature of the probabilities in statistical mechanics

Davey, K. (2008), 'The Justification of Probability Measures in Statistical Mechanics',

Philosophy of Science **75**(1), 28--44.

(*) Loewer, B. (2002), 'Determinism and Chance', *Studies in the History and Philosophy of Modern Physics* **32**, 609--620.

(*) Schaffer, J. (2007), 'Deterministic Chance?', *British Journal for the Philosophy of Science* **58**, 113--140.

Sklar, L. (1993), *Physics and Chance: Philosophical Issues in the Foundations of Statistical Mechanics*, Cambridge University Press, Cambridge, pp. 120-127, 281-293.

Van Lith, J. (2002), "Ergodic Theory, Interpretations of Probability and the Foundations of Statistical Mechanics, *Studies in the History and Philosophy of Modern Physics* 32, 581-594.

Winsberg, E. (2008), 'Laws and Chances in Statistical Mechanics', *Studies in the History and Philosophy of Modern Physics* **39**, 872--888.