

SYLLABUS

Note that the core texts are referred to simply by name and pages, eg. Cassidy, pp. 33-47. Other sources are available in the Course Reader. The first paragraph for each topic gives primary and/or secondary material to be discussed in the seminar, the second offers suggestions for further reading.

Sept. 7 Introduction (Organization and Overview)

Primary Sources:

- Albert Einstein, *The Collected Papers of Albert Einstein, Vol. 1: The Early Years, 1879-1902*, Doc. 22.
- Albert Einstein, "Autobiographical Notes," in P.A. Schilpp, ed. *Albert Einstein: Philosopher-Scientist* (La Salle, IL: Open Court, 1969, 1st ed. 1949), pp. 2-94 on pp. 2-11.

Part 1 Culture in Science

Sept. 14 The Culture of Time and Space

Wolfgang Schivelbusch, *The Railway Journey: Trains and Travel in the Nineteenth Century* (New York: Urizen Books, 1979) "Railroad Space and Railroad Time," pp. 41-50.

Stephen Kern, selections from "Introduction," "The Nature of Time," and "The Nature of Space," *The Culture of Time and Space 1880-1918* (Cambridge, MA: Harvard University Press, 1983), pp. 1-35, 80-81 and 131-154 (focus on the Introduction and browse the rest).

For an intriguing account exploring time machines in scientific culture at the turn of the century see Simon Schaffer, "Time Machines," (unpublished manuscript available from RS).

Sept. 21 Physics circa 1900: Einstein's Forerunners

Primary Sources:

- Ernst Mach, *The Science of Mechanics: A Critical & Historical Account of its Development* (La Salle, IL: Open Court, 1960. 1st (German) ed. 1883), pp. xxii-xxiv and 271-275.
- H.A. Lorentz, "Michelson's Interference Experiment," translated from "Versuch einer Theorie der elektrischen und optischen Erscheinungen in bewegten Körpern," Leiden, 1895, §§ 89-92, in H.A. Lorentz, A. Einstein, H. Minkowski and H. Weyl, *The Principle of Relativity: A Collection of Original Memoirs on the Special and General Theory of Relativity*, translated by W. Perrett and G.B. Jeffery, (New York: Dover, 1923), pp. 3-7.
- Henri Poincaré, "The Theories of Modern Physics," *Science and Hypothesis* (London: Walter Scott, 1905), pp. 160-182.

There are many studies of Mach, Lorentz and Poincaré, often comparing their views with those of Einstein. For a recent overview of the relation of Einstein's work to that of his predecessors see Olivier Darrigol, "The Electrodynamical Origins of Relativity Theory," *Historical Studies in the Physical and Biological Sciences (HSPS)* 26 (1996), 241-312. For an accessible account of the Michelson-Morley experiment see Harry Collins and Trevor Pinch, *The Golem: What You Should Know about Science*, 2nd ed., (Cambridge: Canto, 1998), pp. 27-55 (esp. 27-43) and note the discussion on pp. 151-180. The standard source is Loyd S. Swenson, *The Etherial Aether: A History of the Michelson-Morley Aether-Drift Experiments* (Austin: University of Texas Press, 1972). For a brief sketch of physics at the turn of the century see Richard Staley, "The New Physics: Space and Time on a Photographic Plate," *The Cambridge Review* 116 (May 1995), 3-12.

Sept. 28 Albert and Mileva: Einstein in Bern

Primary Source

- Selections from *The Collected Papers of Albert Einstein, Vol. 1: The Early Years, 1879-1902*, Docs. 22, 50, 52, 92, 96, 114, 129 and 130; and from *The Collected Papers of Albert Einstein, Vol. 5: The Swiss Years, Correspondence, 1902-1914*, Doc. 210.

Review the early chapters of the biography of your choice.

Thomas P. Hughes, "Einstein, Inventors and Invention," *Science in Context* 6 (1993), 25-42.

For studies exploring Einstein's social environment see chapters in Lewis Pyenson, *The Young Einstein* (Bristol: Adam Hilger, 1985) and Lewis S. Feuer, "The Social Roots of Einstein's Theory of Relativity," in *Einstein and the Generations of Science* (New York: Basic Books, 1974), pp. 3-105. Considerable attention has been paid to Einstein's relation to his first wife Mileva since the publication of their correspondence in 1987. See Roger Highfield and Paul Carter, *The Private Lives of Albert Einstein* (London and Boston: Faber and Faber, 1993) and on their daughter, Michele Zackheim, *Einstein's Daughter: The Search for Lieserl* (New York: Riverhead Books, 1999).

Oct. 5 The Origins of Relativity Theory

Primary Sources:

- Albert Einstein, "On the Electrodynamics of Moving Bodies," in John Stachel, ed. *Einstein's Miraculous Year: Five Papers that Changed the Face of Physics* (Princeton, NJ: Princeton University Press, 1998), pp. 123-130, esp. pp. 123-130.
- Selections from *The Collected Papers of Albert Einstein, Vol. 5: The Swiss Years, Correspondence, 1902-1914*, Docs. 27 and 28.

Read one of:

Gerald Holton, "On the Origins of the Special Theory of Relativity," in *Thematic Origins of Scientific Thought: Kepler to Einstein* (Cambridge, MA: Harvard University Press, 1988 revised ed.), pp. 191-236

or

Arthur I. Miller, "The Special Relativity Theory: Einstein's Response to the Physics of 1905," in Gerald Holton and Yehuda Elkana, eds. *Albert Einstein: Historical and Cultural Perspectives* (Princeton: University of Princeton Press, 1982), pp. 3-26.

and

Peter Galison, "Einstein's Clocks: The Place of Time," *Critical Inquiry* 26 (2000), 355-389.

For an overview see John Stachel, "The Theory of Relativity," in R.C. Olby, G.N. Cantor, J.R.R. Christie and M.J.S. Hodge, eds. *Companion to the History of Modern Science* (London and New York: Routledge, 1990), pp. 442-457. For the standard accounts see the full length studies in Holton, *Thematic Origins* and Arthur I. Miller, *Albert Einstein's Special Theory of Relativity: Emergence (1905) and Early Interpretation (1905-1911)* (Reading, Mass.: Addison Wesley, 1981), but note more recent perspective of Darrigol, "Electrodynamic Origins," with its valuable historiographic discussion.

Part 2 Science as Culture**Oct. 12 Theory and Experiment in the Reception of Special Relativity in Germany**

Primary Sources:

- Selections from *The Collected Papers of Albert Einstein, Vol. 5: The Swiss Years, Correspondence, 1902-1914*, Doc. 47.

Cassidy, pp. 35-47.

G. Battimelli, "The Electromagnetic Mass of the Electron: A Case Study of a Non-Crucial Experiment," *Fundamenta Scientiae* 2 (1981), 137-150.

Gerald Holton, "Quanta, Relativity, and Rhetoric," in *Science and Anti-Science* (Cambridge, MA: Harvard University Press, 1993), pp. 74-108, esp. pp. 86-108.

On Planck's role in the development and reception of relativity see Stanley Goldberg, "Max Planck's Philosophy of Nature and his Elaboration of the Special Theory of Relativity," *HSPS* 7 (1976), 125-160 and Pyenson, *The Young Einstein*, pp. 194-214. For an overview of the early development of the theory in Germany see Richard Staley, "On the Histories of Relativity: The Propagation and Elaboration of Relativity Theory in Participant Histories in Germany, 1905-1911," *Isis* 89 (1998), 263-299. For a study of the fortunes of special relativity in Britain see A.C. Warwick, "Cambridge Mathematics and Cavendish Physics: Cunningham, Campbell and Einstein's Relativity 1905-1911. Part I: The Uses of Theory," *Studies in History and Philosophy of Science* 23 (1992), 625-656.

Oct. 19 Early Quantum Theory

Primary Source:

- Selections from *Collected Papers*, Vol. 5, Docs. 37, 47, 87, 88.

Cassidy, pp. 31-34, 48-54.

Martin J. Klein, "Einstein and the Development of Quantum Physics," in *Einstein: A Centenary Volume*, ed. A.P. French, (Cambridge, MA: Harvard University Press, 1979), pp. 133-151.

Thomas S. Kuhn, "Einstein's Critique of Planck," in *Some Strangeness in the Proportion*, ed.

Harry Woolf, (Reading, MA: Addison Wesley, 1980), pp. 186-191.

Christa Jungnickel and Russell McCormmach, *Intellectual Mastery of Nature: Theoretical Physics from Ohm to Einstein*. Volume 2: *The Now Mighty Theoretical Physics, 1870-1920* (Chicago and London: The University of Chicago Press, 1986), pp. 304-321.

Kuhn's reinterpretation of Planck's work (giving new emphasis to Einstein's recognition of the role of quantization in the black-body law) is in Thomas S. Kuhn, *Black-Body Theory and the Quantum Discontinuity 1894-1912* (Chicago and London: University of Chicago Press, 1987), but note the controversy about the account reflected in contemporary book reviews in *Isis* and other journals.

Oct. 26 Proving General Relativity

Primary Source:

- Read the sections on general relativity in Einstein, *Relativity*, chaps 19-32.

Abraham Pais, "'The Happiest Thought of My Life'," in *"Subtle is the Lord...": The Science and the Life of Albert Einstein* (Oxford: Oxford University Press, 1982), pp. 177-183 and if possible browse later chapters.

Harry Collins and Trevor Pinch, "Two Experiments that 'Proved' the Theory of Relativity," and "Afterword" in *The Golem: What You Should Know about Science*, 2nd ed., (Cambridge: Canto, 1998), pp. 27-55 (esp.43-55) and pp. 151-180.

The classic account of the eclipse expeditions is John Earman and Clark Glymour, "Relativity and Eclipses: The British Expeditions of 1919 and Their Predecessors," *HSPS* 11 (1980), 49-85. For an assessment of the different proofs of relativity see Clifford M. Will, *Was Einstein Right? Putting General Relativity to the Test* (New York: Basic Books, 1993, 1st ed. 1986)

Nov. 2 Einstein in Germany

Primary Sources:

- Selections from *Collected Papers*, Vol. 5, Doc. 445, and from *The Collected Papers of Albert Einstein*, Vol. 8: *The Berlin Years, Correspondence, 1914-1918*, Docs. 22-24, 26, 94, 103, 292, 337, 374.

- Selections from Klaus Hentschel, ed. and Ann M. Hentschel, ed. assistant and translator, *Physics and National Socialism: An Anthology of Primary Sources* (Basel, Boston and Berlin: Birkhäuser, 1996), pp. 18-24, 100-109 and 152-161.

Alan D. Beyerchen, "The Background," in *Scientists Under Hitler: Politics and the Physics Community in the Third Reich* (New Haven : Yale University Press, 1977), pp. 1-14, 211-214.

Fritz Stern, "Einstein's Germany," in Gerald Holton and Yehuda Elkana, eds. *Albert Einstein: Historical and Philosophical Perspectives* (Princeton, NJ: Princeton University Press, 1982), pp. 319-343.

Most biographies have discussions of Einstein's experiences in Germany.

Part 3 Science in Culture

Nov. 9 Relativizing Relativity?

Cassidy, pp. 60-74.

Michel Biezunski, "Einstein's Reception in Paris in 1922," in Thomas F. Glick, ed. *The Comparative Reception of Relativity* (Dordrecht: Reidel, 1987), pp. 169-188.

Loren R. Graham, "The Reception of Einstein's Ideas: Two Examples from Contrasting Political Cultures," in Gerald Holton and Yehuda Elkana, eds. *Albert Einstein: Historical and Cultural Perspectives* (Princeton: Princeton University Press, 1982), pp. 107-136.

There are accounts of the scientific and popular reception of relativity in different countries in Glick, *The Comparative Reception*, and Stanley Goldberg, *Understanding Relativity: Origin and Impact of a Scientific Revolution* (Boston: Birkhäuser, 1984). On the popular response in particular see Alan J. Friedman and Carol C. Donley, *Einstein as Myth and Muse* (Cambridge: Cambridge University Press, 1985), Chapter 1 on "The Popularization of the New Ideas," pp. 7-25, and Michel Biezunski, "Popularisation and Scientific Controversy: The Case of the Theory of Relativity in France," in Terry Shinn and Richard Whitley, *Expository Science: Forms and Functions of Popularisation* (Dordrecht: Reidel, 1985), pp. 183-94.

Nov. 16 Quantum Mechanics and Society

Cassidy, pp. 54-59.

Paul Forman, "Weimar Culture, Causality and Quantum Theory, 1918-1927: Adaptation by German Physicists and Mathematicians to a Hostile Intellectual Environment," in Colin Chant and John Fauvel, eds. *Darwin to Einstein: Historical Studies on Science and Belief* (New York: Longman, 1980), pp. 267-302. This is an abridged version of an article that originally appeared in *HSPS* 3 (1971), 1-116.

John Hendry, "Weimar Culture, Causality and Quantum Causality," in Chant and Fauvel, eds. *Darwin to Einstein*, pp. 303-326.

Arthur Fine, "The Young Einstein and the Old Einstein," in *The Shaky Game: Einstein Realism and the Quantum Theory* (Chicago: University of Chicago Press, 1986), pp. 12-25. If interested browse also chapters 1 and 3, pp. 1-39.

Another paper exploring the diverse interpretations of quantum mechanics, and in particular relations to National Socialism in Germany, is J.L. Heilbron "The Earliest Missionaries of the Copenhagen Spirit," *Revue d'histoire des sciences* 38 (1985), 194-230.

Nov. 30 Images: Einstein and the Bomb

Review the relevant sections of the biography of your choice.

Abraham Pais, *Einstein Lived Here* (Oxford: Clarendon, 1994), pp. 214-236.

Alan J. Friedman and Carol C. Donley, "A Myth Portrayed," *Einstein as Myth and Muse* (Cambridge: Cambridge University Press, 1985), pp. 154-194.

For a detailed study of images associated with radioactivity and the bomb see Spencer R. Weart *Nuclear Fear: A History of Images* (Cambridge, Mass.: Harvard University Press, 1988). His discussion of the immediate response to Hiroshima is in Chapter 6, pp. 103-127.

Dec. 7 Einstein and Religion

Primary Sources:

- Albert Einstein, "Science and Religion (I-1939; II-1949)," "The Common Language of Science (1941)," and "Why Socialism? (1949)," in *Out of My Later Years*, (New York: Philosophical Library, 1950), pp. 25-33, 107-109 and 119-126.
- William F. Lawhead, "Religion, Relativity, and Common Sense: Einstein and the Religious Imagination," in *Einstein and the Humanities*, ed. Dennis P. Ryan, 37-45. New York, West Port, Conn. and London: Greenwood Press, 1987).
- Roy D. Morrison II, "Einstein on Kant, Religion, Science and Methodological Unity," in Ryan, *Einstein and the Humanities*, pp. 47-57.

For a valuable recent study see Max Jammer, *Einstein and Religion: Physics and Theology* (Princeton University Press, 1999). Roy D. Morrison II takes a highly philosophical approach to the subject in *Science, Theology and the Transcendental Horizon: Einstein, Kant and Tillich* (Atlanta, GA: Scholars Press, 1994).

Dec. 14 Popularizing Science in the 1920s and the 1990s

Primary Sources:

- Albert Einstein, *Relativity: The Special and the General Theory, A Popular Exposition* (London: Methuen, 1920)
 - Stephen W. Hawking, selections from *A Brief History of Time: From the Big Bang to Black Holes* (Toronto, New York, London, Sydney and Auckland: Bantam, 1988), pp. vi-viii, 15-34, 177-182.
- Daniel J. Kevles, "Popularization and Conservatism," in *The Physicists: The History of a Scientific Community in Modern America* (Cambridge, MA and London: Harvard University Press, 1995), pp. 170-184.
- Bruno Latour, "A Relativistic Account of Einstein's Relativity," *Social Studies of Science* 18 (1988), 3-44.

On Hawking see Hélène Mialet, "Do Angels Have Bodies? Two Stories About Subjectivity in Science: The Cases of William X and Mister H," *Social Studies of Science* 29 (1999), 551-581.

