

The Practice of Science 2014 - an Annotated Bibliography

I've focused on print resources and some of the more obscure or older (but still useful!) resources to complement your web search for useful information on careers and career guidance. Consider the starred (*) articles as essential reading early in your career (or now, if they're new to you). Sample the remainder as time, interest and need—or need of diversion—dictate. Enjoy!

A. Getting Started - Choice of problem and direction

*Kahn, C.R. (1994) Picking a research problem: the critical decision. *New Eng. J. Med.* 330:1530-1533 (excellent advice in the form of 10 easily digested guidelines).

*Davis, M.M. (2000) How to ask questions (in 10 easy steps). *Current Biology* 10:R771. (a complement to Kahn, keyed to quotes from Bob Dylan songs among others).

*Platt, J.R. (1964) Strong inference. *Science* **146**:347-353. (required reading - exposition of the method of multiple working hypotheses and the role of disproof in the progress of science. For an interesting history of the origins of this method see: Pyne, S.T. (1978) Methodologies for geology: G.K. Gilbert and T.C. Chamberlain. *Isis* 69:413-424, at: <http://www.jstor.org/stable/231044>. My thanks to Martin McDonagh, University of Birmingham, Birmingham UK for pointing this reference out to me).

Yewdell, J.W. (2008) How to succeed in science: a concise guide for young biomedical scientists. 'Part I: taking the plunge' and 'Part II: making discoveries'. *Nature Reviews Molec Cell Biol.* 9:413-416 and 491-494. Jon's guide provides good advice together with a little humor.

Fisher, D. (2003). The Henry Kunkel Legacy: through the eyes of his last graduate student. *Lupus* 12:172-174. (another dynasty, this one in a family and based at Rockefeller. David's article captures the essence of Henry as a mentor: the creative spark for your science *must* come from you; smart people will *always* see an interesting angle on any solid result; and the way to build a big, interesting and potentially important story is with that first small, solid experimental result. So get started!).

Maxmen, A. (2009) Taking risks to transform science. *Cell* 139: 13-15, and Anne Sasso's 'Audacity' series in *Science Careers* (indexed at the following link: http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2009_11_06/caredit.a0900139. Big wins require luck, preparation and not a little courage! Lots of stories and inspiration here for scientists of all ages.

Alon, U. (2009) How to choose a good scientific problem. *Molec Cell* 35:726-728. The best of a short series Uri wrote on science in thought and practice.

Lee, A., Dennis, C. and Campbell, P. (2007) *Nature's* guide for mentors. *Nature* 447:791-797. Even though this is billed as a guide *for* mentors, it has a great deal to say about identifying good or great mentors and the important roles a mentor plays in one's scientific career. Have a look!

Two interesting perspectives on the vexing issue of choice of a lab are given in: Holden, C. 'Eight attributes of highly successful postdocs', and Vogel, G. 'A day in the life of a topflight lab' (Bob Langer's lab at MIT), both in the 3 Sept 1999 issue of *Science*.

Wilson, E.O. (2013) *Letters to a Young Scientist*. Liveright Publishing/WW Norton, NY. 245pp. Like so much of what Wilson has written, accessible, engaging and wise. A great complement to the following two books.

Cajal, S. Ramón y (1999) *Advice For A Young Investigator*. MIT Press, Cambridge, MA. 150 pp. (reissue of Cajal's 1897 'career guide'. Includes such interesting chapters as 'Beginner's Traps' and 'Diseases of the Will'. Remarkably prescient! Cajal was a great Spanish neuroanatomist).

Medawar, P.B. (1979) *Advice to a Young Scientist*. Harper & Row, New York. 109pp. (see especially Chapter 3. A very useful and mature perspective from an exceptionally accomplished scientist-writer. Reissued in paperback).

series on-line: Science Magazine's 'Science Careers' site is excellent - many interesting articles and series covering a wide range of career advice and having an excellent collection of on-line resources. See above for a relatively recent example on the need for risk-taking in science. My first stop, as there's always something interesting here before diving into the web and science blogosphere.

series in-print: the 'Sticky Wicket' series in *Journal of Cell Science* is very entertaining, very funny and (usually!) anonymous, as was the previous, now apparently discontinued 'Caveman' series. What redeems this often-biting series is the skillful use of humor to address important topics in science and science or graduate training.

Philip Bourne's 'Ten simple rules' series in *PLoS Computational Biology*, now continued by other authors as well, is great - short succinct articles on a wide range of topics. See examples below. Also, Greg Petsko has also written entertainingly on a range of topics for different journals, most notably and recently his *Genome Biology* series.

HHMI short course: The HHMI funds a series of 'Future Faculty Fellows' boot camps at many institutions including the UW. Sign up if at all possible both for the resources and opportunity to compare notes with other trainees and faculty. For those without access, see the following listing, an attempt by the HHMI to capture a portion of this in useful-free!-form.

Not just for women only: Fiona Watt's series of interviews with prominent women in science ran in the *Journal of Cell Science* from 2003. Almost all address or illuminate issues women face and feel more often than men (sexism, exclusivity, demands of family and children), and often provide trenchant advice. She wrote a summary of this experience and lessons learned in 2006: Watt, F.M. (2006) Women in cell biology: getting to the top. *Nature Reviews Mol Cell Biol.* 7:287-290.

B. Getting Stuff Done - I

Burroughs Wellcome/HHMI (2006) *Making the Right Moves: A Practical Guide to Scientific Management for Postdocs and New Faculty*. 2nd Edition (a 250 pp guide that can be requested free from HHMI or downloaded and printed from the HHMI website where you'll find additional resources: <http://www.hhmi.org/grants/office/graduate/labmanagement.html>. Includes excerpts from the Barker books noted below as well. Very useful advice and free to boot!).

American Society for Cell Biology (2004) *Career Advice for Life Scientists vols I-III*. These books are soft bound and free as pdfs (search the title or see the ASCB website) and a great complement to HHMI above.

Erren, TC, Cullen, P, Erren M, and Bourne, PE (2007) Ten simple rules for doing your best research, according to Hamming. *PLoS Comp Biol* 3(10) e213. A painless introduction to Richard Hamming's advice, distilled from his now-iconic Bell Labs talk, which is much longer and discursive. Reprinted in Smith's collection noted below.

Barker, Kathy (2002,2005) *At the Helm* and *At the Bench: Laboratory Navigator*. Cold Spring Harbor Laboratory Press. (two useful guides, one now in 2nd edition, by Kathy Barker of ISB on setting up and running your lab. *At the Helm* is the more useful of the two for senior students, post-docs and new faculty).

Bliss, E.C. (1976) *Getting Things Done*. Bantam Books, New York. (73 short chapters with a few amusing little drawing on how to tackle daily life. Got me to throw out all the other time management books I bought, but was procrastinating about reading!).

Allen, D. (2001) *Getting Things Done: The Art of Stress-free Productivity*. Penguin Books. (Useful advice on mastering workflow and managing projects. A short gloss is provided by James Fallows in the July/Aug 2004 Atlantic Monthly, entitled 'Organize your life!' pp.171-176).

Hale-Evans, Ron (2006) *Mind Performance Hacks: Tips and Tools for Overclocking Your Brain*. O'Reilly. An engaging collection of short chapters with lots of interesting tips and tricks on things including memory, mental math, creativity, decision-making and 'mental fitness'.

C. Getting Stuff Done II - Design and conduct of experiments

Langmuir, I. (1989) Pathological science. *Physics Today*, October 1989 issue pp.36-48. (transcript of a famous talk given by Nobel Laureate Langmuir at GE in 1953 on pseudoscience and self-delusional thinking. This formerly lost classic was unearthed, transcribed and edited by Robert Hall in 1966). **see also:** Rousseau, D.L. (1992) Case studies in pathological science. *Amer. Scientist* 80:54-63. (This includes the story of the disproof of 'polywater' by use of a sweaty post-handball T-shirt as lab material - this was included as part of what is still probably one of the best 'Methods' notes ever published by Science).

In the same vein is the recently published '*Why People Believe Weird Things*' by Michael Shermer (WH Freeman, 1997 and recently updated). Shermer has also written the 'Skeptic' column for *Scientific American*. Look around - you'll have no trouble finding local examples...

Ledford, H. (2008) With all good intentions. *Nature* 452:682-684 and Hanawalt, P. C. (2006) Research collaborations: trial, trust and truth. *Cell* 126:823-825. (two accessible articles on research collaborations, one of the most important and potentially rewarding-or troublesome-aspect of modern science. Both articles include useful practical advice).

Hawkins, C. and Sorigi, M. (1985) *Research: How to Plan, Speak and Write About It*. Springer-Verlag, Berlin. 184pp. (8 useful chapters on research from start to finish).

Littlefield, J.W. (1984) On the difficulty of combining basic research and patient care. *Am. J. Hum. Genet.* **36**:731-735. (Littlefield's useful advice on how to combine work on clinical and basic aspects of disease).

National Academy Press (1995 +) *On Being a Scientist: Responsible Conduct in Research*, 2nd and subsequent editions. (Responsible conduct of research, and dealing with the ethical dilemmas posed by science, are part of all of our lives. This short booklet has case studies and a good bibliography. You'll receive additional training as part of your graduate career).

D. Essential Skills - Reading, writing and the presentation of science

Warren, K., ed. (1981) *Coping with the Biomedical Literature*, Praeger, New York (useful compilation, with the most useful-and least dated-those of how to approach 'the literature').

Fawcett, P.J. (1978) Personal filing systems revisited. *Ear Nose & Throat J.* **57**:82-89. (an unlikely place for a small gem to appear - timeless principles still applicable today).

Srunk, W. and White, E.B. (1999) *The Elements of Style*. MacMillan, New York. 85pp. (recently revised and updated writer's "bible" - buy it, read it, use it!).

Williams, J.M. (2005) *Style: Ten Lessons in Clarity and Grace*. 8th Edition. Pearson-Longman, New York. 274pp. (Very useful small book of advice that's directly and continuously applicable. Expensive, but worth it).

Thomas, F-N. and Turner, M. (1994) *Clear and Simple as the Truth: Writing Classic Prose*. Princeton University Press, Princeton, NJ. 225 pp. (one of the few recent books that addresses style as other than a 'technical' aspect of writing - includes a useful 'Museum' of examples and good bibliography).

Bourne, P.E. (2005) Ten simple rules for getting published. *PLoS Computational Biology* 1(5):e57 (solid advice that's generally applicable across all fields).

Wells, W.A. (2004) Me write pretty one day: how to write a good scientific paper. *J. Cell Biol* 165:757-758.

Powell, K. (2010) Publish like a pro. *Nature* 467:873-875.

Bredan, A.S. and van Roy, F. (2006) Writing readable prose. *EMBO Reports* 7:846-849. Useful advice in a well-written—and readable—short article.

Peter Cook's Oxford website: <http://users.path.ox.ac.uk/~pcook/w1/resources.htm>. Peter runs the Nuclear Structure and Function Research Group at the Dunn School of Pathology at the University of Oxford. His long-stranding interest in teaching and better-communicating is on display in his 'Resources' page that includes up-to-date material and live links to many very useful resources.

Williams, R.(~1990 on) *The PC (or Mac) is not a Typewriter* series. Peachpit Press, Berkeley. (very useful series of books that provide a painless introduction to typography and a guide on how to better use any word processor/graphics program to produce words/figures that look good on the page and are a pleasure to read. Word processing programs have had the paradoxical effect of institutionalizing lots of typographical mistakes and errors - this series will convince you never to 'fully justify' anything again! Use these books to spot and correct the more egregious mistakes, or to achieve special effects. Little 'how-tos' that make the difference!

More than ink on the real (or virtual) page: For more information on typography, the field once moribund but resurrected by digital fonts, see: "Stop Stealing Sheep, and Learn How Type Works" by Erik Spiekermann and E. M. Ginger. More detail can be found in Robert Bringhurst's classic "The Elements of Typographic Style" an in-depth, workbook-style look at typesetting. Read Carolina de Bartolo's "Explorations in Typography" (or just visit the book's terrific website). And Ellen Lupton's "Thinking With Type" (web link is: <http://www.thinkingwithtype.com/>) provides a good all-round introduction for students or for teaching oneself the basics. For all things typographic, see typographica.org

Calnan, J. and Barabas, A. (1981) *Speaking at Medical Meetings*, 2nd Ed. Heinemann, London. 184pp. (a wide range of useful advice covering many different aspects of speaking. Great figures and cartoons are all illuminated with apt quotes from Shakespeare).

Bailey, N.T.J. (1995) *Statistical Methods in Biology*, 3rd Ed. Cambridge University Press, Cambridge. 255pp. (Everyone needs a 'statistical crutch' - this is mine, and you need to find yours. Good introductions to simple concepts and their application, with a Summary on what approach or test to choose as a function of distribution, sample size and type of comparison. Needs to be used with software, and a biostatistician you can trust and work with).

Swinscow, TDV (200) *Statistics at Square One*. 9th Ed. Revised by MJ Campbell. BMJ Press. (very useful introductory text that first appeared as an articles series in the BMJ. Now available in print or on-line at the BMJ website: <http://www.bmj.com/collections/statsbk/>).

Doerge, R.W. and Bremer, M. (2009) *Statistics at the Bench: A Step-by-Step Handbook for Biologists*. Cold Spring Harbor Laboratory Press. Another excellent edition to the CSH 'At the Bench' series.

Haddock, S.H.D. and Dunn, C.W. (2011) *Practical Computing for Biologists*. Sinauer Associates, Sunderland, MA. Includes a plethora of topics in readily accessible form that are becoming increasingly important: familiarity with text manipulation and command line resources, programming (the appropriately focus on Python), computer graphics, remote access and building simple electronic devices using Arduino. A great way to dip your toe in if you're interested or in need on any of these topics.

Tufte, E.D. (1983/2001) *The Visual Display of Quantitative Information*. 1st/2nd Editions. Graphics Press, Cheshire, CT. 197pp. (Stunning! Most useful work on graphical excellence in theory and practice. After reading this you'll never look at a multicolor, overproduced 3D Powerpoint slide again without weeping at the lost opportunity to accurately and economically convey *information!* See also Tufte's 3 sequels, the most recent of which *Beautiful Information* includes the full text of his 'take-no-prisoner's shred of Powerpoint. All 4 books are equally useful and enjoyable to read or thumb through, as well as stunningly produced - Tufte also teaches a course that includes all of the books in the registration fee).

Gladwell, M. (2002) The social life of paper. New Yorker 25 March issue. (The real skinny on paper, and why it's so useful: paper is a remarkably efficient and versatile, low cost, low tech but 'high-touch' crutch to support the life of the mind. This article starts with air traffic controllers, who use small scraps of paper to track and clear even very busy flight schedules. Available free at the author's website: www.gladwell.com).

E. Style in Science/The Wellsprings of Creativity

Science Masterclass (2011) Lindau Meeting short takes from a range of Nobel laureates on a very wide range of topics. Includes feedback from young scientists attending. Nature 478:S1-S20 (13 Oct 2011 issue). See also the entertaining take in Peter Doherty's 'The Beginner's Guide to Winning the Nobel Prize, esp his Chapter 9 which is reprinted in Reginald Smith's compendium *Scientific Work and Creativity: Advice From the Masters* noted below.

Where do ideas come from? Ideas drive science, so it might be worth dipping a small tow into a little of the voluminous literature on this topic. For starters see the following, a Wikipedia entry and a recent 2009 Keck Futures talk on the topic plus a few items below:

<http://en.wikipedia.org/wiki/Creativity>

http://www.keckfutures.org/conferences/synthetic-biology/Podcast_Tutorials_Foster_Main_Page.html

Holton, G. (1978) Fermi's group and the recapture of Italy's place in physics, Chapter 5 in *The Scientific Imagination: Case Studies*. Cambridge University Press, Cambridge. 382pp. (Fermi was the last great physicist to be equally adept and accomplished as a theoretician and experimentalist. A good account of Fermi's work habits are given in Platt, J.R. (1962) *The Excitement of Science*, Houghton-Mifflin, Boston, Chs. 7 and 8).

Macfarlane, G. (1979) *Howard Florey: The Making of a Great Scientist*. Oxford University Press, Oxford. 396pp. (Fermi's biological counterpart - a great 20th century experimental pathologists, the developer of penicillin and the founder of the Dunn School of Pathology at Oxford).

Kanigel, R. (1986) *Apprentice to Genius: The Making of a Scientific Dynasty*. MacMillan, New York. 271pp. (the engaging and well-written story of the scientific dynasty that started with Steve Brodie is traced through Julius Axelrod, Sol Snyder and Candace Pert. Includes a good informal history of the NIH).

Smith, R. Editor (2012) *Scientific Work and Creativity: Advice From the Masters*. Citizen Scientist League, Clearwater, FL. Great compendium of 29 chapters including many excerpts from famous books and scientists. My thanks to the Editor, Reginald Smith, for bringing this to my attention.

Colapinto, J. (2009) Brain games. *New Yorker* 11 May 2009. A very interesting profile of behavioral neuroscientist Vilayanur Ramachandran, and how great science can be done with a combination of insight and modest resources.

Austin, J.H. (1977) *Chase, Chance and Creativity: The Lucky Art of Novelty*. Columbia University Press, 237pp. (Austin was the long-time Chair of Neurology at Colorado, more recently famous for his excursions into cognitive neuroscience (see also his '*Zen and the Brain*' MIT Press, 1999, 834pp. and sequels). This earlier work is a much more accessible look at the episodes from the author's career, and how a combination of opportunity and insight were leveraged to good advantage. Certainly not the weightiest of works on creativity, but enjoyable. Recently reprinted).

Tharp, T. (2003) *The Creative Habit: Learn It and Use It for Life*. Simon and Schuster, 243pp. (very interesting statement on creativity and the conditions that foster creative thinking from one of the giants of 20th century American modern dance. This book aims to be a practical guide, and is made all the more interesting by where its coming from and by focusing on what promotes creativity across a wide range of disciplines). See also her recent work on collaboration: *The Collaborative Habit: Life Lessons for Working Together* (2009) by Twyla Tharp and Jesse Kornbluth.

Medawar, P. (1982/1990) *Pluto's Republic* and *The Threat and the Glory*, Oxford U.P. and Harper Collins. (Medawar and Thomas (see below) were two of the most engaging and elegant stylists writing science in any century. Both are models of high intelligence, clarity and enthusiasm in presenting science and medicine to the public).

Thomas, L. (1974/79) *Lives of a Cell* and *The Medusa and the Snail*. Viking Press. (see note above. The first of these books was collected from a very unusual (for the time) column Thomas wrote for the *New England Journal of Medicine* entitled 'Notes of a Biology Watcher').

F. The Larger World, and a few just for fun...

Simone, J.V. (1999) Understanding academic medical centers: Simone's maxims. *Clin. Cancer Research* 5:2281-2285. Joe Simone is a senior academic physician who's held leadership roles at several cancer centers, most recently in Utah. After having heard his 'maxims' quoted so many times as wisdom of a sage, I was happy to find that they'd been captured for posterity, amusement and use. Topics include institutional realities, leadership, recruiting, job changing and success.

Frisch, O. (1979) *What Little I Remember*. Cambridge University Press, Cambridge. 227pp. (best title of any set of reminiscences, by a physicist who enjoyed enormously the science he was doing and the company it allowed him to keep. Great informal history of 20th century physics, illustrated with many photos and author's excellent sketches).

Feynman, R.P. (1985) *Surely You're Joking, Mr. Feynman!: Adventures of a Curious Character*. W.W. Norton, New York. 350pp. (Feynman's autobiography in the form of a collection of great stories he told his drumming buddy and fellow physicist Ralph Leighton. A gentle reminder that life and science are supposed to be fun).

Canfield, M.R. (2011) *Field Notes on Science and Nature*, Harvard U. Press. 320pp. A wonderful glimpse with lots of reproduced examples of field notes from a range of scientists using everything from a pencil and paper to electronic capture. Lots of luminaries here, and do I wish I could draw like Jonathan Kingdon!

Dyson, F.J. (1988 on) *Infinite In All Directions*. Perennial/Harper & Row, New York. (these and subsequent lectures in *From Eros to Gaia* (1992), *Imagined Worlds* (1997), and *The Sun, The Genome and The Internet* (1999) are great fun to read for Dyson's intellectual breadth and adventurousness, and his exemplary prose. All in paperback with his reissued autobiography).

Weatherall, D. (1995) *Science and The Quiet Art: The Role of Medical Research in Health Care*. Norton, New York. 378pp. (Excellent introduction, history and defense of the role of basic research in medicine. Regrettably now out of print).

*A good history of whatever field you're working in. You need to know the context in which you're working. The best short introductions to the history of pathology include: Maulitz, R.C. (1993) The pathological tradition, chapter 9 pp.169-191 in Bynum, W.F. and Porter, R., eds. *Companion Encyclopedia of the History of Medicine*, Routledge, London; and Florey, H.W. (1958) The history and scope of pathology, chapter 1, pp.1-20 of *General Pathology*, 2nd edition, H. Florey, Editor, WB Saunders, Philadelphia (a more magisterial and illustrated, though older, short introduction. Both include additional suggestions for reading).

Hessenbruch, A., Editor (2000) *A Reader's Guide to the History of Science*. Fitzroy Dearborn Publishers, London. 934pp. (great compendium of short articles and annotated bibliographies on important areas and figures in the history of science).

Lazebnik, Y. (2002) Can a biologist fix a radio? - Or, what I learned while studying apoptosis. *Cancer Cell* 2:179-182. (amusing meditation on the coming tide of systems thinking as applied to biology. As is often the case, the most useful commentary is again delivered with humor).

G. The University of Washington Research Funding Service: The UW's Research Funding Service (RFS), located in the Health Sciences Library, is a remarkably useful local resource. The RFS provides information on the very practical issue of locating support for your research, and can help you locate funding sources specific to your situation or nationality. A portion of what the RFS provides can be found at their website: <http://healthlinks.washington.edu/rfs/>

Help us with the 2015 Edition! We're interested in your resources on computation and systems issues as applied to biomedical research and training. Send these and other corrections or additions and we'll credit any we use.

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