RESOURCE LETTER

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This is one of a series of Resource Letters on different topics intended to guide college physicists, astronomers, and other scientists to some of the literature and other teaching aids that may help improve course content in specified fields. [The letter E after an item indicates elementary level or material of general interest to persons becoming informed in the field. The letter I, for intermediate level, indicates material of somewhat more specialized nature; and the letter A indicates rather specialized or advanced material.] No Resource Letter is meant to be exhaustive and complete; in time there may be more than one letter on some of the main subjects of interest. Comments on these materials as well as suggestions for future topics will be welcomed. Please send such communications to Professor Roger H. Stuewer, Editor, AAPT Resource Letters, School of Physics and Astronomy, University of Minnesota, 116 Church Street SE, Minneapolis, MN 55455; e-mail: rstuewer@physics.spa.umn.edu.

Resource Letter PBGP-1: Physics books for the general public

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This Resource Letter is a checklist of popular books about physics and some of its allied sciences, grouped by subject and genre. Its principal purpose is to help physics teachers provide advice and guidance to their students and to the lay public.
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I. INTRODUCTION

Civic scientific literacy, which can be defined roughly as the ability to read and understand the Tuesday science section of the *New York Times*, is estimated to be a little below 20% in the United States.[1] In comparison, conventional literacy hovers around 75%. Scholars of scientific literacy warn that this level—a mere fifth of the population—may be insufficient to sustain this century's industrial production and to inform responsible, thoughtful consumption. It may not even be high enough to safeguard the effective exercise of democracy. Important public policy choices associated with emerging energy, information, and biological technologies make unprecedented demands upon scientific literacy. Remedy is possible by two routes. Pre-collegiate and college teachers must obviously bear the brunt of the effort, but informal science educators, including science writers, journalists, movie makers, and web masters must also do their part. This Resource Letter is intended as a helpful tool in the ongoing endeavor to relieve the public's fear of physics by replacing it with an appreciation of the beauty and power of science, and ultimately with understanding.

There is a significant distinction between the intended audiences for the books listed in this bibliography, and for this Resource Letter itself. One consists of every imaginable reader: there is something for all ages and for all levels of expertise from the school child to the professional physicist. The other, by contrast, should include teachers planning popular readings as primary or secondary sources in a course, professional physicists who want a general overview of the field, and writers looking for suggestions. Primarily, though, this bibliography is intended as a handy checklist for readers of the *American Journal of Physics*. All of us are familiar with the experience of having a family member, a student, a neighbor, an acquaintance, or a guest at a party ask us to recommend a good book about relativity, or the Big Bang, or the interpretation of quantum mechanics. For those occasions it is convenient to have on hand a short, selective list of books that address the subject at the appropriate level.

The popular literature about physics-related subjects is vast and growing. For the sake of effectiveness we have purposely kept this list short, trusting that modern methods of electronic searching and data retrieval can cover a much broader area than any Resource Letter. Starting with well over two hundred titles that we are familiar with, or that were recommended by helpful colleagues who kindly responded to our call for suggestions,[2] we have pruned the list to about a hundred, using accuracy, timeliness, and writing style as selection criteria. We know that we have missed many good books, and that our selections necessarily reflect our personal tastes, but we are confident that those we have included represent a useful starting point. If one were to set out to build a library of popular physics books, one might well begin with this core selection. By the same token, all of us should make sure that the catalogues of our institutions and our public libraries include at least this list.

To stay within the bounds of a short checklist, we have restricted ourselves to books, thereby excluding journal articles, films, tapes, CDs, websites, and most textbooks. We include only a tiny, representative selection of biographies and histories, but no fiction, no plays, and no science fiction. Most of the books are about physics, but a few works are included from adjoining disciplines such as mathematics, astronomy, biophysics, geophysics, and oceanography. Originally we had intended to list only books in print, but since many readers have access to good libraries, and since the used and out-of-print book markets have recently become widely accessible on the internet, we decided to relax that

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criterion. For the purpose of electronic searching, we have accepted the recommendation of several of our correspondents to include ISBN numbers.

The ten books marked with an asterisk represent our personal list of favorites. Besides quality they have little in common. They have, each in its own way, struck a chord. Our most difficult chore has been the assignment of levels of difficulty: E for elementary, I for intermediate, and A for advanced. Although we tried to match them to the three levels of background education (primary school, high school, college), and to assign level A to those books that require the understanding of some mathematical equations, we must concede that our effort has not been very successful. All the books in this Resource Letter are intended for the general public, and all are accessible. Some require more intellectual effort than others, but that is true for any written document, and is not a sound criterion for judging quality. In many cases we have succumbed to the temptation of taking the easy way out by picking level I.

II. THE NATURE OF PHYSICS

1. **The Nature of the Physical World**, A. S. Eddington (University of Michigan Press, Ann Arbor, MI, 1958). Based on the Gifford Lectures of 1927, this work is an assessment of the profound changes in scientific thought that resulted from the advent of relativity and quantum theory just a few years earlier. Though dated, the writing is inspired and completely non-mathematical. Still an important historical and scientific document. ISBN: 0472060155. (I)
2. **The Character of Physical Law**, R. P. Feynman (Random House, Inc., New York, 1994). The philosophy of physics from the point of view of a decidedly unphilosophical genius with deep intuitive insight. ISBN: 0679601279. (I)
3. **It Must be Beautiful: Great Equations of Modern Science**, edited by G. Farmelo (Granta, New York, 2002). An anthology of eleven essays (six from physics) by as many authors who unpack the meaning of the key equations of modern science, which are usually avoided in popularizations. ISBN: 1862075557. (I)
4. **Thematic Origins of Scientific Thought: Kepler to Einstein**, G. Holton (Harvard University Press, Cambridge, MA, 1988), revised ed. One of today's most creative historians of science, an exquisitely fluid writer, points out the unheralded role of prejudices and unspoken assumptions, which he calls themata, as background for mathematical analysis and empirical observation. ISBN: 0674877489. (A)
5. **Consilience: The Unity of Knowledge**, E. O. Wilson (Vintage, New York, 1999). A modern-day Lucretius argues eloquently that all science is related and is ultimately reducible to the laws of physics. Consilience, the coming together of explanations from different disciplines, is a promising, newly identified theme (in the sense of Ref. 4) in understanding the nature of science. ISBN: 067976867X. (A)
6. **Seeking Ultimates: An Intuitive Guide to Physics**, P.T. Landsberg (Institute of Physics, Philadelphia, 2000). A wise, witty, and widely accessible, non-mathematical panorama of the current state of physics from quarks to quasars. Keeping the ultimate purpose of science in view, the author does not shy away from touching on questions beyond our reach, out to the limits of knowledge. ISBN: 0750306572. (I)

III. EVERYDAY PHYSICS

7. **How Things Work: The Physics of Everyday Life**, L. A. Bloomfield (John Wiley & Sons, Inc., Somerset, NJ, 2000), 2nd ed. A thick, deservedly popular college textbook explaining the workings of the natural phenomena and technical devices that surround us. Much of it can be understood and appreciated by general readers. Includes clever one-sentence paraphrases of physical laws and some neat demonstration experiments. ISBN: 0471381519. (E)
8. **Clouds in a Glass of Beer: Simple Experiments in Atmospheric Physics,** C. F. Bohren (Dover Publications, Inc., Mineola, NY, 2001). Brings meteorological mysteries down to Earth, and relates them to common phenomena. Sophisticated and witty. ISBN: 0486417387. (E)
9. **Turning the World Inside Out and 174 Other Simple Physics Demonstrations**, R. Ehrlich and J. Walker (Princeton University Press, Princeton, NJ, 1990). What you can learn first-hand about physics from experiments performed at your desk, in your kitchen, and in your backyard. ISBN: 0691023956. (E)
10. ***The Flying Circus of Physics with Answers**, J. Walker (John Wiley & Sons, Inc., Hoboken, NJ, 1977). Over 600 common observations of mundane mysteries in the physical world, phrased in the form of questions. These are by turns simple, strange, and startling; all are baffling. With the help of over 1600 references each puzzle is solved in a brief paragraph. A delight for everyone from six-year olds to Nobel laureates. ISBN: 047102984X. (E)
11. **Science from Your Airplane Window,** E. A. Wood (Dover Publications, Mineola, NY, 1996), revised ed. A surprising wealth of scientific insight rewards travelers who simply keep their eyes open. ISBN: 0486232050. (E)

IV. WAVES AND ELECTROMAGNETISM

12. **Waves and Beaches: The Dynamics of the Ocean Surface**, W. Bascom (Anchor Press). Out of print. For surfers and other watchers of the ocean who want to know what makes it go. ISBN: 0385148453. (E)
13. **Rainbows, Halos, and Glories**, R. Greenler (Peanut Butter Publishing, Seattle, WA, 1999). A lavishly illustrated popular book about nature's profligate display of optical phenomena. An eye-opener. ISBN: 0897169263. (E)
14. **The Fire within the Eye: A Historical Essay on the Nature and Meaning of Light**, D. Park (Princeton University Press, Princeton, NJ, 1999). A thorough, sophisticated examination of the physical nature of light, the psycho-physiological process of seeing, and their subtle, often enigmatic relationships. ISBN: 0691050511. (I)
15. **Driving Force: The Natural Magic of Magnets**, J.D. Livingston (Harvard University Press, Cambridge, MA, 1996). A masterful example of popular writing: Erudite, authoritative, and clever. ISBN: 0674216458. (E)

V. ATOMS AND NUCLEI

16. **The Magic Furnace: The Search for the Origins of Atoms**, M. Chown (Oxford University Press, 2001). Modern cosmology has furnished atoms, once regarded as immutable nuggets, with varied and dramatic life histories. ISBN: 0195143051. (E)
17. **Hydrogen: The Essential Element**, J. S. Rigden (Harvard University Press, Cambridge, MA, 2002). The unique and astonishingly powerful role of the simplest of all atoms in nature, which in turn provides clues to our understanding of all matter. ISBN: 0674007387. (I)
18. **Taming the Atom: The Emergence of the Visible Microworld**, H.C. von Baeyer (Dover Publications, Mineola, NY, 2000). The story of how new instruments have made atoms visible for the first time in their 2500 year history, without, however, making them any less mysterious. ISBN 0486414477. (E)
19. **Nucleus: A Trip into the Heart of Matter**, R. Mackintosh, J. Al-Khalili, B. Jonson and T. Pena (The Johns Hopkins University Press, Baltimore, MD, 2001). Four European nuclear physicists describe their work and its background in a large, lavishly illustrated, widely accessible volume. ISBN: 0801868602. (E)
20. **Megawatts and Megatons: The Future of Nuclear Power and Nuclear Weapons**, R. L. Garwin and G. Charpak (University of Chicago Press, Chicago, IL, 2002). A personal view of crucial social issues at the beginning of the 21st century by two wise and experienced observers of the contemporary scene. Nuclear issues clarified for people who care about a safe and healthy planet. ISBN: 0226284271. (I)

VI. QUANTUM PHYSICS

21. ***Mr. Tompkins in Paperback**, G. Gamow (Cambridge University Press, New York, 1993), 2nd ed., including **Mr. Tompkins in Wonderland** and **Mr. Tompkins Explores the Atom**. The fantastic adven-

tures of a little bank clerk who explores atomic structure, relativity, and quantum theory. Conceived over sixty years ago, Mr. Tompkins remains as entertaining and endearing as ever, especially to those who remember him from their childhood. ISBN: 0521447712. (E)

The New World of Mr. Tompkins, G. Gamow and R. Stannard (Cambridge University Press, Cambridge, 1999). New readers might prefer this deft modern revision of Gamow's classic. Sexisms and obscure allusions are removed without distorting the original. ISBN: 0521630096. (E)

22. **Thirty Years That Shook Physics: The Story of Quantum Theory**, G. Gamow (Dover Publications, Mineola, NY, 1985), reprinted. A lighthearted personal account of the development of the quantum theory, including both biography and physics, by one of its most colorful contributors. ISBN: 048624895X. (I)
23. **The Strange Story of the Quantum**, B. Hoffman (Dover Publications, Mineola, NY 1959). An early but authoritative entry in a long list of popularizations of quantum mechanics by a collaborator of Einstein. ISBN: 0486205185. (I)
24. **In Search of Schrödinger's Cat: Quantum Physics and Reality**, J. Gribbin (New Age Books, New York, 1984). A clear explanation, by a prolific science writer, written at a time when fundamental thought experiments were just beginning to make their way into the laboratory. ISBN: 0553342533. (E)
25. **Where Does the Weirdness Go?: Why Quantum Mechanics Is Strange, but Not as Strange as You Think**, D. Lindley (Basic Books, New York, 2000). A straightforward, popular, up-to-date account. ISBN: 0465067867. (E)
26. **The Cosmic Code: Quantum Physics as the Law of Nature**, H. R. Pagels (Simon & Schuster, New York, 1982). A passionate attempt to translate the physicists' intrinsically quantum mechanical world view into lay language. ISBN: 0671248022. (I)
27. **QED: The Strange Theory of Light and Matter**, R. P. Feynman (Princeton University Press, Princeton, NJ, 1988). In a triumph of reductionism, Feynman derives the observed properties of the world from one single axiom—a simple caricature of the rules of quantum mechanics. The exercise is intellectually challenging, but rewards the diligent reader with a deeper understanding of the mechanics, if not the meaning, of quantum theory. ISBN: 0691024170. (A)

VII. RELATIVITY

28. **One Two Three...Infinity: Facts and Speculations of Science**, G. Gamow (Dover Publications, Mineola, NY, 1988), reprint ed. A *potpourri* of mathematics, physics, biology, and related sciences published in the middle of the 20th century. Many physicists credit this book with helping to awaken their interest in science. Dated but spirited. ISBN: 0486256642. (E)
29. **Einstein's Legacy**, J. Schwinger (Dover Publications, Mineola, NY, 2002). A popularization by a great physicist who is almost unknown to the public. Characteristically, it is technically demanding, but Schwinger's clarity of thought and economy of expression are unmatched. ISBN: 0486419746. (A)
30. ***Black Holes and Time Warps: Einstein's Outrageous Legacy**, K. S. Thorne, with a foreword by S. W. Hawking and an introduction by F. Seitz (W. W. Norton & Company, New York, 1995). A charming, thorough, and carefully organized account by one of the world's leading experts on black holes. Puts relativity and cosmology into their scientific and historical contexts, and spices them with personal anecdotes from a wide circle of colleagues. Can be read in parts or as a whole. Helpful editorial apparatus includes a glossary, a chronology, and a name index. ISBN: 0393312763. (I)
31. **Simply Einstein: Relativity Demystified**, R. Wolfson (W. W. Norton & Company, New York, 2002). Easy to read, well-paced, careful. Although the text contains no math, an appendix provides a quick review of high school math for a quantitative treatment of time dilation. Unconventionally bases the theory exclusively on the principle of relativity, relegating the invariance of the speed of light to Maxwell's theory of electrodynamics. ISBN: 0393051544. (I)
32. **Fearful Symmetry: The Search for Beauty in Modern Physics**, A. Zee (Macmillan Publishing Company, Old Tappan, NJ, 1989). A clear introduction to modern physics at an elementary level. ISBN: 0020409117. (E)

VIII. COSMOLOGY

33. ***The Whole Shebang: A State-of-the-Universe(s) Report**, T. Ferris (Simon & Schuster, New York, 1997). Engagingly written, this book covers a broad range of cosmological topics including cosmic evolution, symmetry, dark matter, and the possibility of multiple universes. If you want to know what's cool and what's weird about physics and cosmology, read this book! ISBN: 0684838613. (I)
34. **The Inflationary Universe: The Quest for a New Theory of Cosmic Origins**, A. H. Guth (Addison-Wesley Longman, Boston, MA, 2000). An exceptionally lucid and compelling exposition of the inflation hypothesis by its inventor. ISBN: 0201328402. (I)
35. **A Brief History of Time: From the Big Bang to Black Holes**, S. Hawking (Bantam Books, New York, 1988), 10th anniversary ed. Probably the only physics book ever mentioned in the Guinness Book of World Records. Covers a broad range of topics including elementary particles, the expansion of the universe, black holes, and the quest for a unifying theory. Comprehensible to anyone with a high school science background, but not as well written as, for example, Refs. 30 and 33 with which it overlaps in subject matter. ISBN: 0553380168. (I)
36. **The Universe in a Nutshell**, S. Hawking (Bantam Books, New York, 2001). This sequel to Ref. 35 brings cosmology up to date in the form of a lavishly illustrated coffee table book with considerable visual appeal. ISBN: 055380202X. (E)
37. **How the Universe Got Its Spots: Diary of a Finite Time in a Finite Space**, J. Levin (Anchor Books, New York, 2003). A highly personal account of how a modern young woman succeeds in the predominantly male world of professional cosmology. Offers rare insight into the way scholarly interests can relate to a scientist's private beliefs and feelings. ISBN: 1400032725. (E)
38. **Our Cosmic Habitat**, M. J. Rees (Princeton University Press, Princeton, NJ, 2003). An accomplished and experienced astronomer surveys the state of cosmology, and comments intelligently on the anthropic principle. ISBN: 0691114773. (I)
39. **The First Three Minutes: A Modern View of the Origin of the Universe**, S. Weinberg (Basic Books, New York, 2000), 2nd ed. The grandfather of popular cosmology books, this beautifully written book inspired many young scientists. An addendum in the second edition is too short to bring it up to date. Technically more demanding than many of its descendants. ISBN: 0465024378. (A)

IX. RELATED SCIENCES

40. **The Annotated Flatland: A Romance of Many Dimensions**, A. A. Abbott and I. Stewart (Perseus Press, Cambridge, MA, 2002). A modern edition of Abbott's 19th century classic fantasy of life in two dimensions. Useful background for grappling with the counterintuitive notion of four-dimensional space–time. The extensive editorial apparatus is helpful, though daunting. ISBN: 190398517X. (I)
41. **From Stone to Star: A View of Modern Geology**, C. Allegre (Harvard University Press, Cambridge, MA, 1994). A riveting introduction to geophysics. ISBN: 067483867X. (I)
42. **Symmetry**, H. Weyl (Princeton University Press, Princeton, NJ, 1983). Gracefully illustrated essay on symmetry in art, nature, and physics by one of the great physicist–mathematicians of the twentieth century. ISBN: 0691023743. (I)
43. **The New Ambidextrous Universe: Symmetry and Asymmetry from Mirror Reflections to Superstrings**, M. Gardner (W. H. Freeman & Company, New York, 1990). Out of print. The inimitable master of mathematical games, and dean of debunkers of scientific humbug, tackles the role of symmetry in science with characteristic zest. ISBN: 0716720922. (I)
44. **Nearest Star: The Surprising Science of Our Sun**, L. Golub and J. M. Pasachoff (Harvard University Press, Cambridge, MA, 2002), reprint ed. Owing to its unique role as both a star and an important element of everyday life, the Sun provides a stepping stone from physics to astrophysics. ISBN: 067401006X. (E)
45. **Parallax: The Race to Measure the Cosmos**, A. Hirshfield (Henry Holt & Company, New York, 2002). A history of the gradual discovery of the true dimensions of outer space. ISBN: 0805071334. (E)
46. **Infinity and the Mind: The Science and Philosophy of the Infinite**, R. Rucker (Princeton University Press, Princeton, NJ, 1995). Clearly

and engagingly written exposition of the conundrums of infinity by a mathematician. Includes a good discussion of Gödel's work. ISBN: 0691001723. (I)

47. **Uncle Tungsten: Memories of a Chemical Boyhood**, O. Sacks (Random House, New York, 2002). In an enchantingly lyrical memoir, a psychiatrist and best-selling writer recalls his childhood exposure to chemistry. A perfect prescription for awakening scientific curiosity in children. ISBN: 0375704043. (E)
48. **What is Life?** (with **Mind and Matter** and **Autobiographical Sketches**), E. Schrödinger (Cambridge University Press, New York, 1992), 2nd ed. With this revolutionary little book written during World War II, the inventor of wave mechanics almost single-handedly launched the field of molecular genetics. ISBN: 0521427088. (I)
49. ***The Double Helix: A Personal Account of the Discovery of the Structure of DNA**, J. D. Watson (Simon & Schuster, New York, 2001). An iconoclastic description of the people and events that contributed to the discovery of the structure of DNA. Details the role of physics (X-ray diffraction, the nature of the chemical bond) in one of the greatest advances in science. ISBN: 074321630X. (E)

X. FUTURE DIRECTIONS

50. **The Universe Next Door: The Making of Tomorrow's Science**, M. Chown (Oxford University Press, New York, 2002). A tour of the most outlandish speculations currently bubbling at the edges of conventional physics. A hundred years from now, most of these ideas will have been discarded—but which ones will survive? An antidote to the notion that physics is dead, but not recommended for the gullible. ISBN: 0195143825. (E)
51. ***Chaos: Making a New Science**, J. Gleick (Penguin Books, New York, 1988). After nearly a century of refuge in the neighboring pasture of pure mathematics, the computer-driven field of nonlinear dynamics (of which chaos is one chapter) has returned to play a permanent and dominant role in physics. Although he has been criticized for selective reporting, the author, a journalist, succeeds brilliantly in evoking the mounting excitement of physicists as they begin to appreciate the significance of this historic development. ISBN: 0140092501. (E)
52. **Chance and Chaos**, D. Ruelle (Princeton University Press, Princeton, NJ, 1993). Comments on many of the issues of Ref. 51 by an accomplished mathematician and profound thinker whose contributions advanced the field in important ways. Urbane and intelligent glimpses of a mathematical physicist at work. ISBN: 0691021007. (A)
53. **Dreams of a Final Theory: The Scientist's Search for the Ultimate Laws of Nature**, S. Weinberg (Vintage, New York, 1994). An eloquent essay on the goal of particle physics, and how it might get there, by one of the leading theorists, and most effective popularizers, of the second half of the 20th century. ISBN: 0679744088. (I)
54. ***The Elegant Universe: Superstrings, Hidden Dimensions, and the Quest for the Ultimate Theory**, B. R. Greene (Vintage Books, New York, 2000). Possibly the best physics popularization of the last decade. Offers a tantalizing description of string theory, which holds promise of finally uniting the two pillars of modern physics, general relativity and quantum mechanics. Densely packed and rich in sophisticated scientific thinking. Recommended for ambitious beginners and those with some college-level science background. ISBN: 0375708111. (I)
55. **Supersymmetry: Unveiling the Ultimate Laws of Nature**, G. Kane with a foreword by E. Witten (Perseus Publishing, Cambridge, MA, 2001), reprint ed. A report from the frontier of particle physics, with a bold prediction of the fundamental revision in our understanding of the fundamental constituents of matter expected from the coming decades of accelerator experiments. ISBN: 0738204897. (I)
56. **The Feynman Processor: Quantum Entanglement and the Computing Revolution**, G. J. Milburn and P. Davies (Perseus Publishing, Cambridge, MA, 1999). Authoritative but highly accessible introduction to the emerging science of quantum computing. ISBN: 0738201731. (I)
57. **Nano: The Emerging Science of Nanotechnology**, E. Regis (DIANE Publishing Company, Collingdale, PA, 1998). Amusing, readable account of the birth of a new technology by a veteran science writer. ISBN: 0788157140. (E)
58. **The Bit and the Pendulum: From Quantum Computing to M Theory - the New Physics of Information**, T. Siegfried (John Wiley & Sons, Inc., Hoboken, NJ, 2000). A science journalist announces the recent addition of the concept of *information* to the tool kit of theoretical physics. ISBN: 0471399744. (I)
59. **The Physics of Star Trek**, L. Krauss (HarperCollins, 1996). A clever account of what is, and what is not, possible according to our current understanding. This highly popular book helps to define the boundary between science and science fiction. ISBN: 0060977108 (E)

XI. HISTORY

60. **Nothingness: The Science of Empty Space**, H. Genz (Perseus Publishing, Cambridge, MA, 2001). The turbulent history of the vacuum by a German physicist and prolific popularizer. Our notion of its properties has oscillated even more wildly than our understanding of the nature of matter. ISBN: 0738206105. (I)
61. **Einstein, History, and Other Passions: The Rebellion against Science at the End of the Twentieth Century**, G. Holton (Harvard University Press, Cambridge, MA, 2000). Instead of simply bemoaning them, the author of Ref. 4 puts today's anti-science, pseudo-science, and scientific illiteracy into their historical context. ISBN: 0674004337. (I)
62. ***The Sleepwalkers: A History of Man's Changing Vision of the Universe**, A. Koestler (Penguin, New York, 1990). Half a century after its publication, this novelistic account of the history of astronomy up to Galileo still has the power to fascinate and entrance. A powerful demonstration of the profound role of science in Western culture. ISBN: 0140192468. (E)
63. **Quantum Generations: A History of Physics in the Twentieth Century**, H. Kragh (Princeton University Press, Princeton, NJ, 2002). A leading historian of science conducts a reliable and compelling tour of the most significant developments in modern physics; replete with fresh insights. ISBN: 0691095523. (I)
64. **The Atom in the History of Human Thought**, B. Pullman (Oxford University Press, NY, 2001). A classically educated quantum chemist retraces the long road of the atom from Greek philosophy and Indian mysticism to its modern conception. Erudite and full of surprising twists. ISBN: 0195150406. (I)
65. **The Making of the Atomic Bomb**, R. Rhodes (Simon & Schuster, New York, 1995). Winner of the Pulitzer Prize and the National Book Award, this is the riveting story of how physics lost its innocence in World War II. ISBN: 0684813785. (E)
66. **Scientists under Hitler**, Alan D. Beyerchen (Yale University Press, New Haven, 1977). What was happening on the other side of the war, and why. ISBN: 0300018304(I)
67. **Absolute Zero and the Conquest of Cold**, T. Shachtman (Houghton Mifflin Company, Boston, MA, 2000). The story of the continuing assault on one of the impenetrable barriers of physics. ISBN: 0618082395. (E)
68. **Warmth Disperses and Time Passes: The History of Heat**, H. C. von Baeyer (Random House, 1999). Original title: **Maxwell's Demon**. An informal history of thermodynamics and its relationship to the arrow of time. ISBN: 0375753729. (E)

XII. BIOGRAPHY

69. **Galileo**, S. Drake (Oxford University Press, New York, 2001). Short and easy introduction to a complex personality, with one possible explanation for the reaction of the church to Galileo's teaching. ISBN: 0192854569. (E)
70. **The life of Isaac Newton**, Richard Westfall (Cambridge University Press, 1994). A condensed version of the currently definitive biography. ISBN: 0521477379. (I)
71. **Albert Einstein: And the Frontiers of Physics**, J. Bernstein (Oxford University Press, New York, 1997). A brief portrait by a theoretical physicist and science writer. This is one of dozens of Einstein biographies. ISBN: 0195120299. (E)
72. **Lise Meitner: A Life in Physics**, R. L. Sime (University of California Press, Berkeley, CA, 1997). The inspiring story of the courageous co-discoverer of nuclear fission who solved formidable scientific problems in the face of male chauvinism and Nazi persecution. ISBN: 0520208609. (E)

73. **Atoms in the Family: My Life with Enrico Fermi**, L. Fermi (University of Chicago Press, Chicago, IL, 1995), 2nd ed. The wife of the last physicist who was at the same time a leading theorist and a great experimentalist inimitably describes him as a human being. Funny and endearing. ISBN: 0226243672. (E)

74. **Portraits of Discovery: Profiles in Scientific Genius**, G. Greenstein (John Wiley & Sons, Inc., New York, 1997). Brief biographies of Boltzmann, Gamow, Feynman and several others, with good treatments of the physical principles involved. ISBN: 0471191388. (E)

XIII. IN THEIR OWN WORDS

75. **Ideas and Opinions**, A. Einstein (DIANE Publishing Company, Collingdale, PA, 2003), reprint ed. A standard selection of Einstein's best essays on science, politics, and life. ISBN: 0756762502. (E)

76. **The Pleasure of Finding Things Out: The Best Short Works of Richard P. Feynman**, R. P. Feynman (Perseus Publishing, Cambridge, MA, 2000). The most impressive and serious of several collections of essays by Feynman. The warm introduction by Freeman Dyson is a masterpiece. ISBN: 0738203491. (E)

77. **Physics and Philosophy: The Revolution in Modern Science**, W. Heisenberg (Prometheus Books, Amherst, NY, 1999). How the classically educated, deeply philosophical co-inventor of quantum mechanics saw the world. ISBN: 1573926949. (I)

78. **Nature and the Greeks** and **Science and Humanism**, E. Schrödinger (Cambridge University Press, New York, 1996). Reflections on the history and philosophy of science by a co-inventor of quantum mechanics who believed passionately in the importance of popularization. ISBN: 0521575508. (I)

79. **Facing Up: Science and Its Cultural Adversaries**, S. Weinberg (Harvard University Press, Cambridge, MA, 2003), reprint ed. A collection of elegant essays by the author of Refs. 39 and 53. ISBN: 0674011201. (I)

XIV. ESSAYS

80. **The Best American Science and Nature Writing 2002**, N. Angier, ed. (Houghton Mifflin, Boston, 2002). One volume in an annual collection of superbly written essays. ISBN: 0618134786. (E)

81. **The Best American Science Writing 2002**, M. Ridley, ed. (Harper Trade, New York, 2002). Competition with Ref. 80. (The two anthologies have been known to pick the same essay!) ISBN: 0060936509. (E)

82. **First You Build A Cloud: And Other Reflections on Physics as a Way of Life**, K. C. Cole (Harvest Books, San Diego, CA, 1999). Engaging brief comments on events and discoveries by an accomplished science journalist. ISBN: 0156006464. (E)

83. **Science a la Mode: Physical Factions and Fictions**, T. Rothman (Princeton University Press, Princeton, NJ, 1991). A theoretical physicist debunks apocryphal anecdotes. ISBN: 0691025215. (I)

XV. RELIGION AND PHILOSOPHY

84. **Science and Human Values**, J. Bronowski (Peter Smith Publisher, Magnolia, MA, 1992). A wise, convincing discussion of the surprising relationships between two endeavors that are often thought to be disjoint. ISBN: 0844665185. (E)

85. **The Tao of Physics: An Exploration of the Parallels Between Modern Physics and Eastern Mysticism**, F. Capra (Random House, Boston, MA, 2000), 25th anniversary ed. A perennial best-seller. Controversial introduction to oriental philosophy and religion and to the principles of modern physics. Emphasizes parallels, but ignores the profound differences that separate them. Based on the obsolete concept of ''particle democracy,'' which has been replaced by the quark theory of matter. ISBN: 1570625190. (E)

86. **Brother Astronomer: Adventures of a Vatican Scientist**, G. Consolmagno (McGraw-Hill Trade; McGraw-Hill Companies, New York, NY, Feb. 2001). The touching, human story of how a believing priest and planetary astronomer reconciles the two poles of his world view. ISBN: 0071372318. (E)

87. **The Mind of God: The Scientific Basis for a Rational World**, P. Davies (Touchstone Books, New York, 1993). The subtitle describes this book more accurately than the title. A prolific science writer asks fundamental questions about knowledge and belief. ISBN: 0671797182. (E)

88. **The Sacred Depths of Nature**, U. Goodenough (Oxford University Press, New York, 1998). An eminent biologist shares thoughtful reflections on the spiritual meaning she derives from a modern scientific understanding of cosmology, evolution, consciousness, and mortality. ISBN: 0195126130. (E)

XVI. GOOD WORDS

89. **Verse and Universe: Contemporary Poems about Science and Mathematics**, K. Brown (Milkweed Editions, Minneapolis, MN, 1998). A rare collection of good poetry that takes science seriously. ISBN: 1571314075. (E)

90. **The Expanded Quotable Einstein**, A. Einstein and A. Calaprice (Princeton University Press, Princeton, NJ, 2000). Delightful, authoritative collection of the words of *Time* magazine's ''Person of the 20th Century.'' The editorial apparatus turns this labor of love into much more than an ordinary book of quotations. ISBN: 0691070210. (E)

91. **Einstein Atomized: Science Cartoons**, S. Harris (Springer-Verlag New York, Incorporated, New York, NY, April 1996). One of half a dozen collections by the dean of science cartoonists. The perfect antidote for academic stuffiness. ISBN: 0387946659. (E)

92. **A Dictionary of Scientific Quotations**, A. L. MacKay (Institute of Physics Publishing, Philadelphia, PA, 1991). A useful, judiciously selected collection by a sophisticated physicist. ISBN: 0750301066. (E)

93. **A Random Walk in Science**, R. L. Weber (Institute of Physics Publishing, Philadelphia, PA, 1999). Stories, jokes, silliness enough to lighten up the most boring lecture. ISBN: 0750306491. (E)
More Random Walks in Science, R. L. Weber (Institute of Physics Publishing, Philadelphia, PA, 1982). ISBN: 0854980407. (E)

XVII. ANTHOLOGIES

94. **The Tests of Time: Readings in the Development of Physical Theory**, L. M. Dolling, A. F. Gianelli and G. N. Statile (Princeton University Press, Princeton, NJ, 2003). An unusual collection of 76 non-mathematical selections about five major physical theories (heliocentric theory, classical electromagnetic theory, quantum theory, relativity theory, big bang theory) from the work of the architects of these theories themselves. A valuable source book for those interested in physics and its history and philosophy. ISBN: 0691090858. (I)

95. ***The World of Mathematics**, J. R. Newman (Dover Publications, Mineola, NY, 2000). Four volumes. The best anthology of popular writings about mathematics and physics from antiquity to the middle of the 20th century, with editorial comments of unparalleled grace and authority. An indispensable resource for readers and writers of popularized physics. ISBN: 0486411532, 0486411508, 0486411516, 0486411524. (E)

96. **The World Treasury of Physics, Astronomy, and Mathematics**, Timothy Ferris, ed. (Little, Brown and Co., Boston, 1993). This cornucopia of a hundred selections by the author of Ref. 33 includes many from books listed in this Resource Letter. His editorial comments are brief and to the point, his range and depth impressive. ISBN: 0316281336. (E)

XVIII. COFFEE TABLE BOOKS

97. **The Ascent of Man**, J. Bronowski (Little, Brown & Company, New York, 1984). Out of print. An album based on one of the first, and still one of the most intelligent, TV series about civilization, including the role of science in history. ISBN: 0316569402. (I)

98. **Niels Bohr: A Centenary Volume**, A. P. French and B. J. Kennedy (Harvard University Press, Cambridge, MA, 1987). This and Ref. 99

combine biographical and scientific essays with photos and anecdotes in a balanced and informative way. ISBN: 0674624165. (I)

99. **Einstein: A Centenary Volume**, A. P. French (Harvard University Press, Cambridge, MA, 1980). ISBN: 0674242319. (I)

100. ***Powers of Ten: About the Relative Size of Things in the Universe**, P. Morrison and P. Morrison (W. H. Freeman & Company, New York, 1994), 2nd ed. An inspiring pictorial tour of the universe poignantly demonstrates the scales on which scientific and human interactions occur. Beginning with an image from deep space, each page brings the reader closer by a factor of 10 to the scale of human activity and then beyond, ending with an imaginary picture of quarks. ISBN: 0716760088. (E)

[1]Jon D. Miller, ''Civic Scientific Literacy: A Necessity in the 21st Century,'' J. Fed. Am. Scientists **55**, 3 (2002).

[2]Hans Christian von Baeyer, ''Looking for good books,'' Am. J. Phys. **70**, 375 (2002).

HOW VS. WHY

. . . 'Does it matter what happened precisely?'

'Of course,' Lower replied.

'Why?'

'Because it is always important to establish the truth.'

'And you think that can be done, do you?'

'Yes.'

Stahl snorted. 'Then you are more optimistic than I am.'

'What do you spend your time doing, then?'

'I amuse my masters,' he replied in a disagreeable tone. 'They want to find out what happens if you mix verdigrice with oil of nitre, so I mix it for them. What happens if you heat it, so I heat it.'

'And then try to work out why it happens.'

He waved his hand airily. 'Pfaf. No. We try to work out how it happens. Not why.'

'There is a difference?'

'Of course. A dangerous difference. The gap between how and why troubles me greatly, as it should you. It is the difference that will bring the world down on our heads.'

Iain Pears, *An Instance of the Fingerpost* (Penguin, New York, 1998), p. 106.

Submitted by Alan DeWeerd.