

## IF MICROBES BEGAT MIND

from origins of life to emergence of intelligence

## WHAT DAEDALUS TOLD DARWIN

about Darwin's dilemma and designing intelligence

Copyright © Zann Gill, 2008

PO Box 4001 Los Altos, CA 94024

Email: [zanngill@desyn.com](mailto:zanngill@desyn.com)

<http://desyn.com>

## REFERENCES

- Abadi, H. and N.C. Wickramasinghe. 1977. *Nature*. Vol. 267. 687 – 688.
- Adami, Christoph. 1998. *Introduction to Artificial Life*. Berlin: Springer-Verlag.
- Ahsen, U von, J Davies, R Schroeder. 1991. Antibiotic inhibition of group I ribozyme function. *Nature* **353**: 368 - 370 (26 September).
- Aktipis, C. Athena. 2000. The Effect of Behavioral Assortment on Selection Dynamics: Externalities, Information Processing and Subjective Commitment. *Artificial Life 7 Workshop Proceedings*.
- Albers and G. L. Alexanderson (eds.). 1985. *Mathematical People: Profiles and Interviews* (Cambridge, MA, 1985), 43-50.
- Allaby, Michael. 1994. *The Concise Oxford Dictionary of Ecology*. Oxford, N.Y.: Oxford University Press.
- Allamandola, Louis J. and Douglas M. Hudgins. 2003. "From Interstellar Polycyclic Aromatic Hydrocarbons and Ice to Astrobiology." Ed. V. Pirronello et al. *Solid State Astrochemistry*. Netherlands: Kluwer Academic Publishers. 251-316.
- Allen, D.A. and D.T. Wickramasinghe. 1981. Discovery of organic grains in comet Wilson. *Nature*. **294**: 239 – 40.
- Apel, C. L., D. W. Deamer, M. N. Mautner, BBA. 2002. *Biomembranes* **1559**: 1 – 9.
- Apel, Charles L., David W. Deamer, Michael N. Mautner. 2002. Self-assembled vesicles of monocarboxylic acids and alcohols: conditions for stability and for the encapsulation of biopolymers. *Biochimica et Biophysica Acta* 1559 (2002) 1 – 9.
- Appenzeller, Tim. 1999. Test Tube Evolution Catches Time in a Bottle: By running experiments on microbes for thousands of generations, researchers are exploring the roles of chance and history in evolution. American Association for the Advancement of Science. *Science* **284**: 2108-2110.
- Armstrong, Howard and Martin Brasier. 2005. *Microfossils*. Second Edition. London: Blackwell.
- Arrhenius, Svante. 1987. [1908] *Worlds in the Making*. London: Harpers in *Earth, Moon and Planets* 37: 187-99.

Altenberg, Lee. 2000. "Evolvability Checkpoints Against Evolutionary Pathologies." *Artificial Life 7 Workshop Proceedings*.

*Artificial Life II*. 1992. Ed. Langton, C.G., C. Taylor, J.D. Farmer, and S. Rasmussen. Redwood, CA: Addison-Wesley.

*Artificial Life IV*. 1994. Ed. M. Sipper, G. Tempesti, D. Mange, and E. Sanchez, editors. Cambridge MA: Bradford Books, M.I.T. Press.

*Artificial Life VI*, 1998. Ed. C. Adami, R.K. Belew, H. Kitano, and C.E. Taylor. Cambridge, MA: M.I.T. Press.

*Artificial Life VII*. 2000. Ed. Mark A. Bedau, John S. McCaskill, Norman H. Packard, and Steen Rasmussen. Cambridge, MA: Bradford Books, M.I.T. Press.

*Artificial Life 7 Workshop Proceedings*. 2000. Ed. Carlo C. Maley and Eilis Boudreau.

*Artificial Life VIII 2002. Proceedings of the Eighth International Conference on Artificial Life*. Ed. Russell K. Standish, Mark A. Bedau, and Hussein A. Abbass. Cambridge, MA: Bradford Books, M.I.T. Press.

*Artificial Life IX 2004. Proceedings of the Ninth International Conference on the Simulation and Synthesis of Living Systems*. Ed. Jordan Pollack, Mark Bedau, Phil Husbands, Takashi Ikegami, and Richard A. Watson. Cambridge, MA: Bradford Books, M.I.T. Press.

*Artificial Life X 2006. Proceedings of the Tenth International Conference on the Simulation and Synthesis of Living Systems*. Ed. Luis M. Rocha, Larry M. Yaeger, Mark A. Bedau, Dario Floreano, Robert L. Goldstone, and Alessandro Vespignani. Cambridge, MA: Bradford Books, M.I.T. Press.

Axelrod, Robert. 1984. *The Evolution of Cooperation*. N. Y.: Basic Books.

\_\_\_\_\_. 1997. *The Complexity of Cooperation: Agent-Based Models of Competition and Collaboration*. Princeton University Press.

Ayala, Francisco J. and Theodosius Dobzhansky, eds. *Studies in the Philosophy of Biology: Reduction and Related Problems*. University of California Press 1974.

Babbage, Charles. 1899. *Babbage's Calculating Engines*, vol II., Charles Babbage Institute Reprint Series for the History of Computing, London: Clowes and Sons.

Bachmann, P.A., Luisi, P.L., and Lang, J. 1992. Autocatalytic self-replicating micelles as models for prebiotic structures. *Nature*. **357**:57-59.

Bak, Per. 1996. *How Nature Works*. N.Y.: Springer-Verlag.

Baldwin, J.M. 1896. A New Factor in Evolution. *American Naturalist*. **30**. 441-451.

Barr, Avron, Paul R. Cohen and Edward A. Feigenbaum. Editors. 1989. *The Handbook of Artificial Intelligence*. IV. Addison-Wesley Publishing Company Inc.

- Bartel, David P. and Szostak, Jack W. 1993. Isolation of new ribozymes from a large pool of random sequences. *Science*. **261**:1411 – 1418.
- Bateson, William. 1894. Materials for the study of variation: treated with special regard to discontinuity in the origin of species. London: Macmillan and Co.
- Bechtel, William and George Graham. 1998. *A Companion to Cognitive Science*, Oxford: Blackwell.
- Becquerel, P. 1924. *Bull. Soc. Astron.* **38**. 393.
- Bedau, M.A., McCaskill, J.S., Packard, N.H., Rasmussen S., Adami, C, Green, D.G., Ikegami, T. Kaneko, K., Ray, T. S. 2000. Open problems in artificial life. *Artificial Life*. **6**(4):363 – 376.
- Bedau, Mark and Norman Packard. 2003. “Evolution of Evolvability via adaptation of mutation rates.” *Biosystems*. **69**:143-162.
- Bedau, M.A. 1996. “The nature of life.” In M. Boden. Ed. *The Philosophy of Artificial Life*. Oxford University Press. 332 – 357.
- \_\_\_\_\_. 1997a. “Weak Emergence.” *Philosophical Perspectives*. **11**:375 – 399.
- \_\_\_\_\_. 1997b. “Emergent Models of Supple Dynamics in Life and Mind.” *Brain and Cognition*. **11**:5 – 27.
- \_\_\_\_\_. 1998. “Philosophical Content and Method of Artificial Life” in T. W. Bynam and J. H. Moor, eds., *The Digital Phoenix: How Computers are Changing Philosophy*. London: Basil Blackwell. 135-152.
- Behe, Michael J. 1996. *Darwin’s Black Box: The Biochemical Challenge to Evolution*. N.Y.: Simon and Schuster.
- Bernal, J.D. 1951. *The Physical Basis for Life*. London: Routledge and Kegan Paul.
- \_\_\_\_\_. 1967. *The Origin of Life*. N.Y.: World Publishing Company.
- Bernstein, Max P. 2006. Prebiotic materials from on and off the early Earth. *Philosophical Transaction of the Royal Society of London Biological Sciences*. October 29; 361(1474): 1689–1702. Published online September 11, 2006.
- Bernstein, Max P., Scott A. Sandford and Louis J. Allamandola. 1999. “Life’s Far-Flung Raw Materials,” *Scientific American*. July.
- Bernstein, M. P., S. A. Sandford, L. J Allamandola, J. S. Gillette, S. J. Clemett, & R. N. Zare. 1999. “UV Irradiation of Polycyclic Aromatic Hydrocarbons in Ices: Production of Alcohols, Quinones, and Ethers.” *Science* **283**:1135 – 1138.
- Bernstein, Max P., Jason P. Dworkin, Scott A. Sandford, George W. Cooper and Louis J. Allamandola. 2002. Racemic Amino Acids from the ultraviolet photolysis of interstellar ice analogues, *Nature*. **416**. Letters. 28 March.

Bhushan, Nalini and Stuart Rosenfeld Editors. 2000. *Of Minds and Molecules: New Philosophical Perspectives on Chemistry*. Oxford University Press.

Blair, N.E. and Bonner, W.A. 1981. A model for the enantiomeric enrichment of polypeptides on the primitive earth. *Orig. Life*. 11(4):331-335.

Blake, David F. and Peter Jenniskens. 2001. "The Ice of Life." *Scientific American*. August.

Blank, Jennifer. 2002. "Processing of Organic Material During Cometary Impacts." #14. ISSOL 2002.

Blumberg, Baruch S. 1995. "Complex interactions of hepatitis B virus with its host and environment." *Journal of the Royal College of Physicians London*. 29: 31 – 40.

Blumberg, Baruch S. 2006. "Hepatitis B Virus. Conjectures on human Interactions and the Origin of Life" in *Life as We Know It*. Vol, 10 of the series Cellular Origins, Life in Extreme Habitats and Astrobiology. Ed. J. Sechbach. Dordrecht, NL: Springer.

Boghossian, Paul A. 1998. "What the Sokal Hoax Ought to Teach Us". Koertge, Noretta, ed. *A House Built on Sand: Exposing Postmodernist Myths About Science*. Oxford University Press.

Bongard, Josh C. and Lipson, Hod. 2004. "Once More Unto the Breach: Co-evolving a Robot and its Simulator." *Artificial Life IX*.

Bonner, W.A. 1999. Chirality amplification — the accumulation principle revisited. *Orig. Life and Evol. Biosphere*. 29:615-623.

Boucher, Douglas A. 1985. Ed. *The biology of mutualism: Ecology and Evolution*. Oxford University Press.

Bowler, P.J. 1984. *Evolution – the History of an Idea*. Berkeley: University of California Press.

Boyd, R. and P.J. Richardson. 1988. The evolution of reciprocity in sizable groups. *J. Theoretical Biology*. June 7; 132 (3): 337-56.

Brasier, Martin. 2002. *Nature* 416:76-81.

Broad, C. D. and Lewy, C. 1975. *Leibniz: An Introduction*. London: Cambridge University Press.

Bronowski, Jacob. 1974. *The Ascent of Man*. Boston: Little Brown.

\_\_\_\_\_. 1977. *A Sense of the Future*. Cambridge: M.I.T. Press. 186-8.

\_\_\_\_\_. 1978. *The Origins of Knowledge and Imagination*. Silliman Lectures at Yale University in 1967. Yale University Press.

Brooks, Rodney. 2000 [1991]. Intelligence Without Representation. In John Haugeland Ed. *Mind Design II*.

\_\_\_\_\_. 2001. The relationship between matter and life. *Nature*. 409:409-11. 18 January.

Brown, Kenneth A. 1988. Interview with Maxime Faget. *Inventors at Work*. Redmond, WA: Microsoft Press.

Buchanan, Andrew, Mark Triant, and Mark A. Bedau. 2004. "The Flexible Balance of Evolutionary Novelty and Memory in the Face of Environmental Catastrophes." *Artificial Life IX*.

Bunnin, Nicholas and E.P. Tsui-James ed. 1996. *Blackwell Companion to Philosophy*. Oxford: Blackwell.

Burkhardt, Richard Wellington. 1977. *The Spirit of System: Lamarck and Evolutionary Biology*. Harvard University Press.

Bush, Vannevar. 1945. "As We May Think." *The Atlantic Monthly*. July.

Buss, Leo. 1997. *The Evolution of Individuality*. Princeton University Press.

Cairns, J., J. Overbaugh, and S. Miller. 1988. The Origin of Mutants. *Nature*. **335**:142 – 145.

Cairns-Smith, A.G. 1966. The origin of life and the nature of the primitive gene. *Journal of Theoretical Biology*. 10. 53–88.

\_\_\_\_\_. 1968. An approach to a blueprint for a primitive organism. In Waddington, Towards a Theoretical Biology, vol. 1. 57—66.

Cairns-Smith, A. G., P. Ingram and G.L.Walker. 1972. "Formose production by minerals, possible relevance to the origin of life." *Journal of Theoretical Biology*. **35**. 601 – 4.

Cairns-Smith, A.G. and G. L. Walker. 1974. "Primitive Metabolism." *Biosystems*. **5**. 173 – 186.

Cairns-Smith, A.G. 1975. A case for an alien ancestry, Proceedings of the Royal Society. B. **189**. 249 – 74.

\_\_\_\_\_. 1982. *Genetic Takeover*. Cambridge University Press.

\_\_\_\_\_. 1984. "On the Rocks: the vital cocktail" in Nash, Sara, Editor. *Science and Uncertainty*. Proceedings of a Conference held under the auspices of IBM United Kingdom Ltd. London. March IBM United Kingdom Ltd. 25 – 42.

\_\_\_\_\_. 1985. *Seven Clues to the Origin of Life*. Cambridge University Press.

\_\_\_\_\_. 1988. The chemistry of materials for artificial Darwinian systems. *International Revs. Phys. Chem.* 7. 209 – 250.

\_\_\_\_\_. 1996. *Evolving the Mind: on the nature of matter and the origin of consciousness*. Cambridge University Press.

\_\_\_\_\_. 2005. "Sketches for a Mineral Genetic Material." *Elements*. **1**. 157– 161.

Campbell, Anthony K. 2003. "What Darwin Missed." *Astrophysics and Space Science*. **285**: 571 – 585.

Campbell, D. T. 1960. Blind variation and selective retention in creative thought as in other knowledge processes. *Psychological Review*. **67**: 380 – 400.

Cate, Jamie H., Marat M. Yusupov, Gulnara Zh. Yusupova, Thomas N. Earnest, and Harry F. Noller. 1999. “X-ray Crystal Structures of 70S Ribosome Functional Complexes.” *Science*. Vol 285. Issue 5436. September 24. 2095 – 2104.

Chaitin, Gregory. 2005. *Meta Math!* N.Y.: Pantheon.

Chamberlin, TC and RT Chamberlin. 1908. Early Terrestrial conditions that may have favored Organic Synthesis. *Science*. **28**. 897 – 911.

Chen, Irene A., Richard W. Roberts, and Jack W. Szostak. 2004. The Emergence of Competition Between Model Protocells. *Science*. **305**. September 3. 1474 – 1476.

Churchland, Paul. 1984. *Matter and Consciounesss*. Cambridge, MA: M.I.T. Press.

\_\_\_\_\_. 1985. *Images of Science: Scientific Realism versus Constructive Empiricism*. University of Chicago Press.

\_\_\_\_\_. 1989. *A Neurocomputational Perspective: The Nature of Mind and the Structure of Science*. MIT Press.

\_\_\_\_\_. 1995. *The Engine of Reason, The Seat of the Soul: A Philosophical Journey into the Brain*. MIT Press.

Chyba, C. and C. Sagan. 1992. Endogenous production, exogenous delivery and impact-shock synthesis of organic molecules: an inventory for the origins of life. *Nature*. Vol. **355**. 125 – 132.

\_\_\_\_\_. 1997. *Science*. May 27.

Chyba, C., P. Thomas, L. Brookshaw, and C. Sagan. 1990. Cometary Delivery of Organic Molecules to the early Earth. *Science*. **249**. 366 – 373.

Cleland, Carol and Christopher Chyba. 2002. “Defining Life.” ISSOL 2002.

Chyba, Christopher F. and Kevin P. Hand. 2005. Astrobiology: The Study of the Living Universe. *Annual Review of Astronomy and Astrophysics*. **43**:31 – 74.

Committee on the Limits of Organic Life in Planetary Systems, Committee on the Origins and Evolution of Life, National Research Council. 2007. *The Limits of Organic Life in Planetary Systems*. Washington, D. C. National Academies Press.

Corning, Peter A. The Co-Operative Gene: On The Role of Synergy in Evolution. *Evolutionary Theory*. **11**. 1996: 183 – 207.

\_\_\_\_\_. 2005. *Holistic Darwinism: Synergy, Cybernetics, and the Bioeconomics of Evolution*. University of Chicago Press.

Cosmides, L. and J. Tooby. Cytoplasmic inheritance and intragenomic conflict. *Journal of Theoretical Biology*. **89**: 83 – 129.

Cosmovici, C.B. et al. 1996. *Planet. Space Sci.* **44**. 735.

Crick, Francis H.C. 1968. The Origin of the Genetic Code. *Journal of Molecular Biology*. **38**:369 – 370.

\_\_\_\_\_. 1981. *Life Itself: Its Order and Nature*. N.Y.: Simon and Schuster.

Crick, F. and L.E. Orgel. 1973. “Directed Panspermia.” *Icarus*. **19**:341 L – 346.

Crick, Francis. 1994. *The Astonishing Hypothesis: The Scientific Search for the Soul*. New York: Charles Scribner’s Sons.

Darwin, Charles. 1859 [1872]. *Origin of Species*. Sixth edition. Chapter XV. “Recapitulation and conclusion.” For reference to changes in the various editions, see *The Origin of Species: A Variorum Text* 1959. Ed. Morse Peckham. Philadelphia: University of Pennsylvania Press.

\_\_\_\_\_. 1985 [1871]. *Correspondence of Charles Darwin*. Eds. Frederick Burkhardt and Sydney Smith. Cambridge University Press.

\_\_\_\_\_. 1883. [1871]. *The Descent of Man and Selection in Relation to Sex*. NY: D. Appleton and Co.

\_\_\_\_\_. 1888. Ed. Francis Darwin. *The Life and Letters of Charles Darwin*. **2**. NY: D. Appleton and Co.

\_\_\_\_\_. XII. Geographical Distribution: Means of Dispersal. *On the Origin of Species*. The Harvard Classics. 1909 – 14.

Davia, Christopher James. 2003. “Minds, Brains and Catalysis: An Ontological Approach.” Presented: *International Conference on Complex Systems*. June 10 – 14, 2002. Manuscript submitted to *Behavioral and Brain Sciences*.

Davies, Paul. 1988. *The Cosmic Blueprint: New Discoveries in Nature’s Creative Ability to Order the Universe*, N.Y.: Simon and Schuster.

\_\_\_\_\_. 1999. *The Fifth Miracle*. N.Y.: Simon and Schuster.

\_\_\_\_\_. 2004. *The Origin of Life*. N.Y.: Penguin.

Davis, Wanda L. and Chris McKay. 1996. Origins of Life: A Comparison of Theories and Application to Mars. *Origins of Life and Evolution of the Biosphere*. **26**. 61 –73.

Davydov, OV. 1995. “Problem of the genetic code structure: new data and perspectives.” In *Evolutionary biology and related areas of physiochemical biology*. Ed. B. F. Poglazov, B. I. Kurganov, M. S. Kritsky & K. L. Gladilin. Moscow: Bach Institute of Biochemistry, Russian Academy of Sciences.

\_\_\_\_\_. 2002. “Trial Homology of the Genetic Code: Biological Significance.” #125. ISSOL.

Dawkins, Richard. 1976. *The Selfish Gene*. Oxford University Press.

- \_\_\_\_\_. 1982. *The Extended Phenotype: The Long Reach of the Gene*. Oxford University Press.
- \_\_\_\_\_. 1986. *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design*. London: W.W. Norton.
- \_\_\_\_\_. 1995. *River Out of Eden: A Darwinian View of Life*. NY: Basic Books. Science Masters Series.
- \_\_\_\_\_. 1995. "Where d'you get those peepers?" *New Statesman and Society*. Vol. 8. June 16. 29.  
<http://www.simonyi.ox.ac.uk/dawkins/WorldOfDawkinsarchive/Dawkins/Work/Articles/1995-06-16peepers.shtml>
- de Duve, Christian. 1995a. *Vital Dust: The Origin and Evolution of Life on Earth*. N.Y.: Basic Books.
- \_\_\_\_\_. 1995b. The Beginnings of Life on Earth. *The American Scientist*. Sept. – Oct.
- \_\_\_\_\_. 2002. Closing Plenary. ISSOL 2002.
- \_\_\_\_\_. 2005. The onset of selection. *Nature*. **433**:581-582
- Deamer, David. 1997. "The first living systems: A bioenergetic perspective." *Microbiology and Molecular Biology Review*. **61**(2): 239-261.
- Deamer, David and Gail Fleischaker. 1994. *Origins of Life: The Central Concepts*. Boston: Jones and Bartlett.
- Deamer, David and Gail L. Barchfield. 1982. Encapsulation of Macromolecules by Lipid Vesicles under Simulated Prebiotic Conditions. *Journal of Molecular Evolution*. **18**:203–206. N.Y.: Springer-Verlag.
- Deamer, David, Jason P. Dworkin, Scott A. Sandford, Max P. Bernstein, and Louis J. Allamandola. 2003. The First Cell Membranes. *Astrobiology* **2**. 4. © Mary Ann Liebert, Inc.
- Dulbecco, Renato. 1987. *The Design of Life*. Yale University Press.
- Dembski, William and Michael Ruse. Eds. 2004. *Debating Design: From Darwin to DNA*. Cambridge University Press.
- Dennett, Daniel. 1984. *Elbow Room*. Cambridge, MA: Bradford Books Division: M.I.T. Press.
- \_\_\_\_\_. 1995 *Darwin's Dangerous Idea*. N.Y.: Touchstone. Simon and Schuster.
- Depuy, J. P. 2000. *The Mechanization of Mind: On the Origins of Cognitive Science*. Princeton: Princeton University Press.
- Descartes, Rene. 1985. *The Philosophical Writings of Descartes*. 3 vols. Eds. John Cottingham, Robert Stoothoff, Dugald Murdoch. Cambridge University Press.  
 [1637]. Discourse on the Method.

[1644]. Principles of Philosophy.  
[1628, 1701]. Rules for the Direction of the Mind.

Di Caro, G. and M. Dorigo. 1998. Ant Colonies for Adaptive Packet Routing in Packet-switched Communications Networks. Proceedings of the 5<sup>th</sup> International Conference PPSN. Berlin: Springer.

Diamond, Jared. 1996. *Guns, Germs, and Steel*. N. Y.: W.W. Norton.

Dicke, S.J. 1998. *Life on Other Worlds: The 20<sup>th</sup> Century Extraterrestrial Debate*. Cambridge University Press.

*Dictionary of Philosophy of Mind*.

<http://www.artsci.wustl.edu/~philos/MindDict/emergence.html>

Di Paolo, E. A. 2000. Searching for Rhythms in Random Boolean Networks. *Artificial Life VII*.

Dorin, Alan. 2000. Creating a Physically-based, Virtual Metabolism with Solid Cellular Automata. *Artificial Life VII*.

Downing, Keith. 2000. Exploring Gaia Theory: Artificial Life on a Planetary Scale. *Artificial Life VII*.

Dreyfus, Hubert. 1991. *Being-in-the-World: A Commentary on Heidegger's Being and Time, Division I*. Cambridge: M.I.T. Press.

\_\_\_\_\_. 1997. "Artificial Intelligence" in Embree, Lester et. al. eds. *Encyclopedia of Phenomenology*, Boston, Dordrecht, London: Kluwer Publishers. 34-39.

Dupré, John. 1993. *The Disorder of Things: Metaphysical Foundations of the Disunity of Science*. Cambridge, MA. Harvard University Press.

Dworkin J.P., D. W. Deamer, S. A. Sandford, L. J. Allamandola. 1998. "Self-Assembling Amphiphilic Molecules: Synthesis in Simulated Interstellar/Precometary Ices" *Proceedings of the National Academy of Science, USA*. **98**:815–819.

Dyson, Freeman. 1982. A model for the origin of life. *J. Mol. Evol.* **18**:344 – 350.

\_\_\_\_\_. 1985. *Origins of Life*. Cambridge: Cambridge University Press.

\_\_\_\_\_. 1992. *From Eros to Gaia*. N.Y. Pantheon.

\_\_\_\_\_. 2005. The Darwinian Interlude: Biotechnology will do away with species. Good: cultural evolution is better than natural selection. MIT Technology Review. March.

Dyson, George. 1998. *Darwin Among the Machines: The Evolution of Global Intelligence*. Cambridge, MA: Perseus Books.

Earle, Sylvia. 1995. *Sea Change*. G.P. Putnam and Sons.

Eckardt, Lars Henning; Naumann, Kai; Matthias Pankau, Wolf; Rein, Michael; Schweitzer, Markus; Windhab, Norbert; von Kiedrowski, Guenter. 2002. DNA nanotechnology: chemical copying of connectivity. *Nature*. London, United Kingdom. **420** (6913). 286.

Edelman, Gerald. 1987. *Neural Darwinism: The Theory of Neuronal Group Selection*. NY: Basic Books.

Eddington, Arthur. 1939. *The Philosophy of Physical Science*, N.Y.: The Macmillan Co.

Ehrenfreund, P. M.P. Bernstein, J. P. Dworkin, S. A. Sandford, L. J. Allamandola. 2001. "The photostability of amino acids in space." *The Astrophysical Journal*. **550**:L95 – L99.

Ehrenfreund, Pascale and Steven B. Charnley. 2000. Organic Molecules in the Interstellar Medium, Comets, and Meteorites: A Voyage from Dark Clouds to Early Earth. *Annual Review of Astronomy & Astrophysics*. **38**:427 – 483.

Eigen M. 1971. Self-Organization of Matter and the Evolution of Biological Macromolecules. *Naturwiss*. **58**:465 – 523.

Eigen M. and P. Schuster. 1979. *The Hypercycle: A Principle of Natural Self-Organization*. N.Y.: Springer-Verlag.

Eigen, Manfred and Ruthild Winkler. 1981. *Laws of the Game: How the Principles of Nature Govern Chance*. N.Y.: Knopf.

Eigen, M. Lindemann, B.F. Tietze, M., Winkler-Oswatitsch, R, Dress, A. and von Haesler, A. 1989. *Science*. **244**. 673.

Eigen, Manfred. 1992. *Steps towards Life*. N.Y.: Oxford University Press.

Eldredge, N. and Gould, S.J. 1972. "Punctuated equilibria: an alternative to phyletic gradualism" in *Models in paleobiology*. Ed. by Schopf, TJM Freeman, Cooper & Co. Doubleday. San Francisco. 82 – 115.

Eldredge, N., and S.N. Salthe. 1984. Hierarchy and evolution. In *Oxford Surveys in Evolutionary Biology*, Volume 1, ed. R. Dawkins and M. Ridley. Oxford University Press. 184 – 208.

Eldredge, Niles. 1985. *Unfinished Synthesis: Biological hierarchies and modern evolutionary thought*. Oxford University Press.

\_\_\_\_\_. 1995a. *Reinventing Darwin*. N.Y.: John Wiley & Sons. 177.

\_\_\_\_\_. 1995b. Undreamt Philosophies. Foreword to Lynn Margulis and Dorion Sagan. *What is Life?* N.Y.: Simon and Schuster.

Eliot, T.S. 1963. *Collected Poems 1909 – 1962*. London: Faber and Faber.

Ertem, G. and J.P. Ferris. 1996. "Synthesis of RNA Oligomers on heterogeneous templates." *Nature* **379**:238 – 240.

- Eschenmoser, A. 1994. "Chemistry of potentially prebiological natural products." *Origins Life Evol. Biosphere.* **24**:389 – 423.
- Escobar, Elva. 2002. Alchichica: A Saline and Highly Alkaline Lake with Modern Stromatolites. ISSOL.
- Farmer, J. D., S. A. Kauffman, and N.H. Packard. 1986. Autocatalytic replication of polymers. *Physica D* **22**:50 – 67.
- Fausto-Sterling, A. 1993. Is Nature Really Red in Tooth and Claw? *Discover* **14**:24 – 27.
- Fernando, Chrisantha and Ezequiel Di Paolo. 2004. "The Chemoton: A Model for the Origin of Long RNA Templates." *Artificial Life IX*.
- Ferris, J.P., P.C. Joshi, E.H. Edelson, and J.G. Lawless. 1978. HCN: A plausible source of purines, pyrimidines and amino acids on the primitive Earth. *J. Mol. Evol.* **11**:293 – 311.
- Ferris, James P., Chun-Hsien Huang, and William J. Hagan Jr. 1988. Montmorillonite: A Multifunctional Mineral Catalyst for the Prebiological Formation of Phosphate Esters. *Origins of Life and Evolution of the Biosphere.* **18**:121 – 133.
- Ferris, J.P. and G. Ertem. 1993. *Journal American Chemical Society* **115**:12270–12275.
- Feyerabend, Paul. 1987. *Farewell to Reason*. London, N.Y.: Verso.
- Fine, Arthur. 1984. "The Natural Ontological Attitude" in J. Leplin, ed. *Scientific Realism*. Berkeley: University of California Press.
- Fisher, R. 1930. *The Genetical Theory of Natural Selection*. Clarendon Press, Oxford.
- Fleischaker, Gail. 1988. *Autopoiesis: the System, Logic, and Origin of Life*. Boston, MA. Boston University Professors Program, The Graduate School.
- Fleischacker, G.R., S. Colonna and P. L. Luisi, Editors. 1994. "Self-production of supramolecular structures." NATO ASI Series, Kluwer Academic Press.
- Foerster, Heinz von. 1973. "On Constructing a Reality." Address given on April 17 to the Fourth International Environmental Design Research Association Conference at the College of Architecture, Virginia Polytechnic Institute, Blacksburg, VA.
- Folk, R.L. 1997. "Nanobacteria: Size limits and evidence. Response." *Science.* **276**:1777.
- Folk, R.L., and Lynch, F.L. 1997. "Nanobacteria are alive on Earth as well as Mars." Ed. R.B. Hoover, Proceedings *SPIE*, San Diego. **3111**:406–419.
- Fontana, Walter. 2001. "The Evolution of Novelty." BEACON Paper. September.
- \_\_\_\_\_. Modeling 'Evo-Devo' with RNA. *BioEssays.* **24**:1164–1177.

Forterre, Patrick. 1992. New hypotheses about the origins of viruses, prokaryotes and eukaryotes. *Frontiers of Life*. Ed. Trần Thanh Vân J.K., Mounolou, J.C., Schneider, J. and Mc Kay, C. Editions Frontières, Gif-sur-Yvette. France. 221 – 234.

\_\_\_\_\_. 1995. Looking for the most ‘primitive’ organism(s) on Earth today: the state of the art. *Planetary and Space Science*. **43**:167 – 177.

Forterre, P., N. Benachenhou, F. Confalonieri, M. Duguet, C. Elie, and B. Labedan. 1993. The nature of the last universal ancestor and the root of the tree of life, still open questions. *Biosystem* **28**:15 – 32.

Foucault, Michel. 1970. *The Order of Things*. N.Y.: Tavistock Publications.

Fox, G. & Woese, C. R. 1975. *Nature*. **256**:505 – 507.

Fox, S.W. and D.K. Harada. 1958. Thermal Copolymerization of amino acids to a product resembling protein. *Science*. **128**:1214.

Fox, S.W. and C.R. Windsor. 1970. Synthesis of Amino Acids by the Heating of Formaldehyde and Ammonia. *Science* **170**:984 – 986

Fox, S.W. and K. Dose. 1977. *Molecular Evolution and the Origin of Life*. N.Y.: Marcel Dekker.

Fox, S. W. 1988. *The Emergence of Life; Darwinian Evolution From the Inside*. NY: Basic Books, Inc., Publishers.

Fox, Sidney W. 1991. *Synthesis of Life in the Lab? Defining a Protoliving System*. Quarterly Review of Biology. Vol. 66. No. 2. June.

\_\_\_\_\_. 1995. “To cellular life and neurocellular assemblies.” *Evolutionary Biochemistry and Related Areas of Physicochemical Biology*. Ed. B. F. Poglazov, B. I. Kurganov, M. S. Kritsky, and K. L. Gladilin, Bach Institute of Biochemistry and ANKO, Moscow.

Frank, F.C. 1953. Spontaneous asymmetric synthesis. *Biochem. Biophys. Acta*. **11**:249.

Frazer, Sir James George. 1959. *The New Golden Bough*. NY: Criterion Books.

Freund, Minoru M. and Friedemann T. Freund. 2006. Solid Solution Model for Interstellar Dust Grains and Their Organics. *The Astrophysical Journal*. **639**:210 – 226. March 1. The American Astronomical Society.

Fry, Iris. 1995. “Are the different hypotheses on the emergence of life as different as they seem?” *Biology and Philosophy*. **10**:389 – 417.

\_\_\_\_\_. 2000. *The Emergence of Life on Earth*. NJ: Rutgers University Press.

Fuller, R. Buckminster. 1946 – 51. “A Comprehensive Anticipatory Design Science,” in “The Fuller Research Foundation,” reprinted 1967. *No More Secondhand God*. Carbondale, Ill.: Southern Illinois University Press.

\_\_\_\_\_. 1961. "World Game" proposed as core curriculum for Southern Illinois University Edwardsville. Re-presented in 1964 for the 1967 International and Universal Exposition in Montreal, Quebec. Incorporated into the World Game Institute, 1972. Assets purchased by o.s. Earth, 2001.

\_\_\_\_\_. 1963 a. *Ideas and Integrity: a Spontaneous Autobiographical Disclosure*. Edited by Robert W. Marks. N.Y.: Collier Books.

\_\_\_\_\_. 1963 b. *No More Secondhand God and Other Writings*. Garden City: Doubleday.

\_\_\_\_\_. 1963 c. [1938]. *Nine Chains to the Moon*. Southern Illinois University

\_\_\_\_\_. 1969. *operating manual for spaceship earth*. Southern Illinois University Press.

\_\_\_\_\_. 1970. *I seem to be a verb*. NY: Bantam Books. Press. N.Y.: Doubleday Anchor Books.

\_\_\_\_\_. 1982. Guinea Pig B\* (for Bucky) his last manuscript before his death.

<http://www.westnet.com/~crywalt/inventions/invtotal.html>

Fuller, R. Buckminster and Applewhite, E. J. 1975. *Synergetics*. New York: Macmillan.

Funes, Pablo, Belinda Orme, and Eric Bonabeau. 2004. "Shaping collective behavior: an exploratory design approach." *Artificial Life IX*.

Ganti, T. 2003. *The Principles of Life*. Oxford University Press.

Gerhart, John and Marc Kirschner. 2007. The theory of facilitated variation. PNAS. May 9.

Gesteland, Raymond F. and John F. Atkins, Editors. *The RNA World*. Cold Spring Harbor Laboratory Press, 1993.

Gilbert, W. 1986. "The RNA World." *Nature*. **319**:618.

Gill, S.P. (Zann). 1986. "The Paradox of Prediction." *Daedalus: Journal of the American Academy of Arts and Sciences*. 115.3: 17 – 49, republished by Academic Press.

Gill, Zann. December 1999. A Design Method Using Darwinian Principles for Collaborative Problem-Solving Environments (CPSEs). CSCL99 (Computer-Supported Cooperative Learning), Stanford University.

\_\_\_\_\_. 2001. Webtank Design: intranet support for collaborative problem-solving; HCI International 2001; published in *Systems, Social, and Internationalization: Design Aspects of Human Computer Interaction vol 2*. edited by Michael Smith and Gavriel Salvendy. N.J.: Lawrence Erlbaum Assoc. 2001. p. 292-6.

\_\_\_\_\_. 2001. Webtanks: Tools for Learning by Design. Siggraph.

\_\_\_\_\_. 2002. "Origin of Life: Case Studies of Hypothesis Construction." #51. ISSOL 2002.

\_\_\_\_\_. 2002. Designing a Think Tank to Study Design paper #4941 AIAA Space Architecture Symposium. Houston, Texas. Section: Design Analysis, Methods, & Theory for Space Architecture.

\_\_\_\_\_. 2002. Webtank (think tank on the web) and the management of organizational complexity. New England Complex Systems Institute. 4<sup>th</sup> International Conference on Complex Systems (ICCS).

Gillespie, D., S. Spiegelman. 1965. A quantitative assay for DNA-RNA hybrids with DNA immobilized on a membrane. *Journal of Molecular Biology*. **12** (3): 829 – 42.

Glaserfeld, Ernst von. 1976. Cybernetics and cognitive development. *Cybernetics Forum*. **8**:115 –120.

\_\_\_\_\_. 1979. Cybernetics, experience, and the concept of self, in M. N. Ozer. Ed. *A Cybernetic Approach to the Assessment of Children: Toward a More Humane Use of Human Beings*. Boulder CO: Westview Press. 67 – 113.

Glickman, Matthew R. and Katia Sycara. 2000. Evolvability and Static vs. Dynamic Fitness. in *Artificial Life 7 Workshop Proceedings*.

Gobet, F., and Simon, H.A. 1996. The roles of recognition processes and look-ahead search in time-constrained expert problem solving: Evidence from grand-master-level chess. *Psychological Science*. **7** (1) 52 – 55.

Gogarten, J. P., Doolittle, W. F. and Lawrence, J. G. 2002. Prokaryotic Evolution in Light of Gene Transfer, *Molecular Biology and Evolution* **19**:2226 – 2238.

Gogarten, J. P., and Townsend, J. P. 2005. Horizontal gene transfer, genome innovation, and evolution. *Nature Reviews in Microbiology* **3**(9) 679 – 687.

Goldsmith, Edward. 1989. “Gaia and Evolution.” *The Ecologist*. **19**: 4.

Goldstein, Alan H. 2006. “I, Nanobot.” Salon.com. March 9.

Goodman, Nelson. 1983. *Fact, Fiction, and Forecast*. Cambridge, MA: Harvard University Press.

Goodwin, Brian. 2001. *How the Leopard Changed its Spots: The Evolution of Complexity*. Princeton University Press.

Goodwin, B. and P. Saunders, Editors. 1989. *Theoretical Biology: Epigenetic and Evolutionary Order from Complex Systems*. Edinburgh: Edinburgh University Press.

Gould, Stephen Jay. 1977. “On heroes and fools in science.” In S. J. Gould. *Ever Since Darwin*. NY: Dutton. 201 – 206.

\_\_\_\_\_. 1982. “Bathybius and eosoon.” In S. J. Gould. *The Panda’s Thumb*. NY: WW Norton. 36 – 244.

\_\_\_\_\_. 1989. *Wonderful Life*. NY: W. W. Norton.

- \_\_\_\_\_. 1992. "Impeaching a self-appointed judge." *Scientific American*. July 118–121.
- \_\_\_\_\_. 1997. "Non-overlapping Magisteria." *Natural History*. **106**. 2:16–22, 60–62.
- Gould, S. J. and R. C. Lewontin. 1979. "The Spandrels of San Marco and the Panglossian paradigm: A critique of the adaptationist programme." *Proc. Royal Soc. London*. **B 205**:581–598.
- Grabowski, P. J., A. J. Zaug, & T. R. Cech. 1981. The intervening sequence of the ribosomal RNA precursor is converted to a circular RNA in isolated nuclei of tetrahymena. *Cell*. February. **23**. 2. 467 – 476.
- Gray, Asa. 1876. *Darwiniana*. NY: D. Appleton.
- Gray, M. W. and W. F. Doolittle. 1982. Has the endosymbiont hypothesis been proven? *Microbiology Review*. March. 46(1): 1–42.
- Gray, M.W. 1996. "The third form of life." *Nature*. **383**:300.
- Grim, Patrick, Evan Selinger, Robert Rosenberger, Randy Au, Nancy Louie, and John Connoll. 2004. "Reducing Prejudice: A Spatialized Game-Theoretic Model for the Contact Hypothesis." *Artificial Life IX*.
- Grobstein, Paul. 1988. "From the Head to the Heart: Some thoughts on similarities between brain function and morphogenesis, and on their significance for research methodology and biological theory." *Experientia* **44**; 960 – 971.
- Gruber, Howard E. 1974. *Darwin on Man: A Psychological Study of Scientific Creativity*. N.Y.: E.P. Dutton.
- Guerrier-Takada, C., K. Gardiner, T. Marsh, N. Pace and S. Altman. 1983. *Cell*. **35**: 849 – 57.
- Guerrier-Takada, C., and S. Altman. 1984. *Science*. **223**: 285-286.
- Guzman, A., A Negron-Mendoza, and S. Ramos-Bernal. 2002. Stability of Adenine Adsorbed in a Clay Mineral in a High Radiation Field. # 80. ISSOL 2002.
- Haken, Hermann. 2004. *Synergetics: Introduction and Advanced Topics*. Berlin: Springer.
- Haken, Hermann. 2006. *Information and Self-organization*. N.Y. Springer.
- Hadamard, Jacques. [1945] 1954. *Psychology of Invention in the Mathematical Field*. Originally published by Princeton University Press. Reissued by Dover.
- Haldane, J.B.S. 1924[1923]. *Daedalus or Science and the Future*, a paper read to the Heretics, Cambridge on February 3. London: Kegan Paul, Trench, Trubner & Co. Ltd.
- \_\_\_\_\_. 1947. *What is Life?* New York: Boni and Gaer; London: Alcuin Press, 1949.
- \_\_\_\_\_. 1967 [1929]. The Origin of Life. first published in *The Rationalist Annual*. Reprinted in J. D. Bernal. *The Origin of Life*. London: Weidenfeld & Nicolson. 242-249.

\_\_\_\_\_. 1985 [1949]. *On Being the Right Size*. New York: Boni and Gaer; London: Alcuin Press.

\_\_\_\_\_. 1986. Edited by John Maynard Smith. *On Being the Right Size and other Essays*. "The Origin of Life." Oxford University Press. 101 – 112.

Hamilton, W.D. 1964. The genetical evolution of social behaviour I and II. *Journal of Theoretical Biology*. **7**: 1-16 and 17-52.

Hammond, Allen and Lynn Margulis. 1981. Farewell To Newton, Einstein, Darwin..., *Science* **81**. December. 55 – 57.

Hanczyc, Martin M., Shelly M. Fujikawa, and Jack W. Szostak. 2003. "Experimental Models of Primitive Cellular Compartments: Encapsulation, Growth, and Division." *Science*. **302**. October 24. 618 – 621.

Hanczyc, Martin M. and Jack W. Szostak. 2004. Replicating vesicles as models of primitive cell growth and division. *Current Opinion in Chemical Biology*. **8**: 660 – 664.

Hardin, Garrett. 1968. The Tragedy of the Commons. *Science*. **162**: 1243 – 48.

Hargreaves, V.W., S.J. Mulvihill, D.W. Deamer. 1977. Synthesis of phospholipids and membranes in prebiotic conditions. *Nature*. **266**. 78 – 80.

Hargreaves, W. R., and D. W. Deamer. 1978. Liposomes from ionic, single-chain amphiphiles. *Biochemistry*. **17**:3759 – 3768.

Harth, E. 1976. "Visual Perception: A Dynamic Theory" *Biol. Cybernetics*. NY: Springer Verlag. **22**:169 – 180.

\_\_\_\_\_. 1982. *Windows on the Mind*. N.Y.: Morrow.

\_\_\_\_\_. 2005. *The Creative Loop: How the Brain Makes a Mind*. N.Y.: Helix Books.

Harvey, Inman. 2004. "Homeostasis and Rein Control: From Daisyworld to Active Perception." *Artificial Life IX*.

Haugeland, John. Ed. 1982. *Mind Design: Philosophy, Psychology, Artificial Intelligence*. Cambridge, MA: M.I.T. Press.

\_\_\_\_\_. 2000. *Mind Design II: Philosophy, Psychology, Artificial Intelligence*. Cambridge, MA: M.I.T. Press.

Hawkins, Jeff with Sandra Blakeslee. *On Intelligence: How a New Understanding of the Brain will Lead to the Creation of Truly Intelligent Machines*. NY: Henry Holt. 2004.

Hazen, Robert M. 2005. *gen•e•sis: The Scientific Quest for Life's Origin*. Washington, D.C.: Joseph Henry Press.

Heinz, Bettina. 2002. Origins of Nitrogen Fixation – The Importance of Molybdenum and Pteridines. #163. ISSOL 2002.

- Heisenberg, Werner. 1958. *Physics and Philosophy* N.Y.: Harper and Row, Harper Torchbooks.
- \_\_\_\_\_. 1972. *Physics and Beyond: Encounters and Conversations*, N.Y.: Harper Torchbooks.
- Hempel, Carl. G. 1965. *Aspects of Scientific Explanation and Other Essays in the Philosophy of Science*. N.Y.: Collier-Macmillan Ltd.
- Herdewijn, Piet. 2001. "TNA as a Potential Alternative to Natural Nucleic Acids." *Angew. Chem. Int. Ed.* **40**. 12. 2249 – 2251.
- Herdewijn, Piet. Notes. 2003.
- Hinton, G.E. and SJ Knowlan. 1987. How Learning Can Guide Evolution. *Complex Systems*. **1**: 495 – 502.
- Hodges, Andrew. 1999. *Turing*. N.Y.: Routledge.
- Hoelzer, Guy, John Pepper, and Eric Smith. Forthcoming. On the Logical Relationship Between Natural Selection and Self-Organization.
- Hofstadter, Douglas R. 1979. *Gödel, Escher, Bach: an Eternal Golden Braid*. N.Y.: Basic Books.
- \_\_\_\_\_. 1985. *Metamagical Themas: Questing for the Essence of Mind and Pattern..* N.Y.: Bantam Books.
- Hofstadter, Douglas R. and the Fluid Analogies Research Group. 1995. *Fluid Concepts and Creative Analogies: Computer Models of Fundamental Mechanisms of Thought*. N.Y.: Basic Books.
- Hofstadter, D. R. and M. Mitchell. 1994. The Copycat project: A model of mental fluidity and analogy-making. In K. Holyoak and J. Barnden Eds. *Advances in Connectionist and Neural Computation Theory*. vol 2: Analogical Connections. Norwood, NJ: Ablex Publishing Corporation.
- Richard Hofstadter. 1944. *Social Darwinism in American Thought*. Philadelphia: University of Pennsylvania Press.
- Holland, John H. 1993. [1975]. *Adaptation in Natural and Artificial Systems*. Cambridge, MA: M.I.T. Press.
- Holland, John H. 2003. "Challenges for Agent-based Modeling." <http://www.nd.edu/~swarm03/Keynote/keynote.html>
- Holton, Gerald. 1988. *Thematic Origins of Scientific Thought*. Cambridge, MA: Harvard University Press, 2nd ed.
- \_\_\_\_\_. 1998. *The Scientific Imagination*. Cambridge, MA: Harvard University Press.
- Horgan, J. 1991. "In the beginning." *Scientific American*. February. 114-125.

Horowitz , N.H. 1945. On the Evolution of Biochemical Syntheses. *Proc. Nat'l Acad. Sci. U.S.A.* 31.153-7.

House, Christopher, Nils Holm et. al. 2002. Exploration of Subsurface Pacific Microbial Ecosystems. #45. ISSOL.

Howsman, Thomas G., Daniel O'Neil, and Michael A. Craft. 2004. "A Stigmergic Cooperative Multi-Robot Control Architecture."

Hoyle, Fred. *Intelligent Universe*. 1984. NY: Holt Rinehart, Winston.

Hoyle, Fred and Chandra Wickramasinghe. 1978. *Lifecloud: the Origin of Life in the Universe*. London: Dent.

\_\_\_\_\_. 1997. *Life on Mars? The Case for a Cosmic Heritage*. Clinical Press Limited. Redland Green Farm. Redland, Bristol, UK.

Huber, C. and G. Wachterhauser. 1997. "Activated acetic acid by carbon fixation on (Fe, Ni)s under primordial conditions." *Science* **276**:245 – 247.

\_\_\_\_\_. 1998. "Peptides by activation of amino acids with CO on (Ni, Fe)S surfaces: Implications for the origin of life." *Science* **281**: 626 – 627.

Huber, C., W. Eisenreich, and G Wächterhäuser 2003. A possible primordial peptide cycle. *Science*. **301**:938 – 940.

Huberman, B.A. and N.S. Glance. 1993. Evolutionary Games and Computer Simulations. *Proceedings of the National Academy of Sciences. USA*. **90**.7715 – 7718.

Hud, Nicholas V. and Frank A. L. Anet. 2000. Intercalation-Mediated Synthesis and Replication: A New Approach to the Origin of Life. *Journal of Theoretical Biology*. **205**. 543 – 562.

Hudgins, Douglas M., Charles Bauschlicher, and L. J. Allamandola. 2005. Variations in the Peak Position of the 6.2 $\mu$ m Interstellar Emission Feature: A Tracer of n in the Interstellar Polycyclic Aromatic Hydrocarbon Population. *The Astrophysical Journal*. **632**:316 – 332. October 10.

Hutchins, Edwin. 1999. *Cognition in the Wild*, Cambridge. M.I.T. Press.

Huxley, Thomas Henry. 1937. *Autobiography and Selected Essays*. Boston: Houghton Mifflin Co.

Hyman, S. E. 1966. *The Tangled Bank: Darwin, Marx, Frazer, and Freud*. N.Y.: The Universal Library, Grosset and Dunlap.

Ingber, Donald E. 1993. Cellular tensegrity: defining new rules of biological design that govern the cytoskeleton. *Journal of Cell Science* **104**. 613 – 627.

\_\_\_\_\_. 1998. The Architecture of Life: A universal set of building rules seems to guide the design of organic structures — from simple carbon compounds to complex cells and tissues. *Scientific American*. January.

\_\_\_\_\_. 2000. Problems and paradigms: The origin of cellular life. *Bioessays* **22**:1160 – 1170. John Wiley & Sons Inc.

Ingber, Donald E., Steven R. Heidemann, Phillip Lamoureux, and Robert E. Buxbaum. 2000. Controversies in physiology: opposing views on tensegrity as a structural framework for understanding cell mechanics. *J. Appl. Physiol.* **89**. 1663 – 1668.

Ingber, Donald E. 2003. Tensegrity I. Cell structure and hierarchical systems biology. *Journal of Cell Science.* **116** (7)1157 – 1173.

\_\_\_\_\_. 2003. Mechanosensation through integrins: Cells act locally but think globally. PNAS. February 18. vol. 100 no. 4. 1472 – 1474. <http://www.pnas.org/cgi/doi/10.1073/pnas.0530201100>

ISSOL 2002. Proceedings of the 13<sup>th</sup> International Conference on the Origin of Life. June 30 – July 5, 2002. Oaxaca, Mexico.

Jablonka, Eva and Marion J. Lamb. 1995. *Epigenetic Inheritance and Evolution: the Lamarckian Dimension*. Oxford University Press.

\_\_\_\_\_. 2005 [1995]. *Evolution in Four Dimensions*. MIT Press.

Jacob, F. et J. Monod. 1961. Genetic regulatory mechanisms in the synthesis of proteins. *J. Mol. Biol.* **3**. 318 – 356.

Jaspers, Karl. *Kant* [from *The Great Philosophers, Volume I*]. Ed. Hannah Arendt. Trans. Ralph Manheim. N.Y.: Harcourt Brace. 1962.

Jeans, James. 1930. *The Mysterious Universe*, London: Penguin.

Johnson, N., S. Rasmussen. C. Joslyn, L. Rocha, S. Smith, and M. Kantor. 1998. “Symbiotic Intelligence: Self-organizing knowledge on distributed networks driven by human interactions.” *Artificial Life VI*.

Johnson, Norman L. 2000. Developmental Insights into Evolving Systems: Roles of Diversity, non-Selection, Self-Organization, Symbiosis in *Artificial Life VII*.

Jones, Steve. 2000. *Darwin’s Ghost: The Origin of Species Updated*. N. Y.: Random House.

Jordanova, L.J. 1984. *Lamarck*. N.Y. Oxford University Press.

Joy, Bill. 2000. “Why the future doesn’t need us.” *Wired Magazine*. April. <http://www.wired.com/wired/archive/8.04/joy.html>

Joyce, Gerald F. 1989. “RNA evolution and the Origins of Life.” *Nature* **338**:217 – 224.

\_\_\_\_\_. 1991. “The Rise and Fall of the RNA World.” *The New Biologist*. **3**. 399 – 407.

\_\_\_\_\_. 1992. “Directed Molecular Evolution.” *Scientific American*. December. 90 – 97.

\_\_\_\_\_. 2002. “The Antiquity of RNA-based Evolution.” *Nature*. **418**(6894):214 – 221.

Kampis, George and Laszlo Gulyas. 2004. "Sustained Evolution from Changing Interaction." *Artificial Life IX*.

Kant, I. 1965 [1781]. *Critique of Pure Reason*. Trans. N. Kemp Smith. N.Y.: St. Martin's Press.

Kasting, J. F. 1993. "Earth's early atmosphere." *Science* **259**:920 – 926.

\_\_\_\_\_. 1997. "Habitable zones around low mass stars and the search for extraterrestrial life." *Origins Life Evol. Biosphere*. **27**:291 – 307.

Kasting, James F. 1998. The Carbon Cycle, Climate and the Long-Term Effects Of Fossil Fuel Burning. *Consequences*. Vol. 4. Number 1.

Kauffman, Stuart. 1969. "Metabolic stability and epigenesis in randomly constructed genetic nets." *Journal of Theoretical Biology*. **22**:437 – 467.

\_\_\_\_\_. 1991. "Antichaos and Adaptation." *Scientific American*. August. 78 – 84.

\_\_\_\_\_. 1993. *The Origins of Order: Self-Organization and Selection in Evolution*. N.Y.: Oxford University Press.

\_\_\_\_\_. 1995. *At Home in the Universe: The Search for the Laws of Self-Organization and Complexity*. N. Y.: Oxford University Press.

\_\_\_\_\_. 2000. *Investigations*. Oxford University Press.

\_\_\_\_\_. 2008. *Beyond Reductionism: Reinventing the Sacred*. NY: Basic Books.

Kauffman, S.A. and R.G. Smith. 1986. Adaptive Automata Based on Darwinian Selection. *Physica D*.

Kelly, Kevin. "Out of Control: The New Biology of Machines." 1995 reprint [1994]. Fourth Estate: London. 470 – 471.

Kenyon and Steinman. 1969. *Biological Predestination*. N. Y.: McGraw-Hill.

Kiedrowski, Guenter von; Eckardt, Lars-Henning; Naumann, Kai; Pankau, Wolf Matthias; Reimold, Malte; Rein, Michael. 2003. Toward replicatable, multifunctional, nanoscaffolded machines. A chemical manifesto. *Pure and Applied Chemistry*. **75**(5). 609 – 619.

Kimura, M. 1983. *The Neutral Theory of Molecular Evolution*. Cambridge: Cambridge University Press.

Kirschner, Marc and John C. Gerhart. 1997. *Cells, Embryos, and Evolution*. Boston: Blackwell Science.

\_\_\_\_\_. 1998. Evolvability (Perspective). *Proceedings of the National Academy of Science*. USA **95**: 8420-8427.

\_\_\_\_\_. (1998). Comment on "Epigenetic inheritance in evolution." [Commentary] *Journal of Evolutionary Biology* **11**: 213-217.

\_\_\_\_\_. 2005. *The Plausibility of Life: Resolving Darwin's Dilemma*. New Haven: Yale University Press.

Kirschner, M.W. 2005. The Meaning of Systems Biology (commentary). *Cell*. **121**:503-504.

Kitcher, Philip. 1982. *Abusing Science*. Cambridge, MA: M.I.T. Press.

\_\_\_\_\_. 1998. "A Plea for Science Studies" in Koertge, Noretta, Ed. *A House Built on Sand: Exposing Postmodernist Myths About Science*. Oxford University Press.

Kortenkamp, S. J., and G. W. Wetherill, 2000. Terrestrial planet and asteroid formation in the presence of giant planets. I. Relative velocities of planetesimals subject to Jupiter and Saturn perturbations, *Icarus* **143**: 60 – 73.

Kratschmer, W., L.D. Lamb, K. Fostiropoulos, D.R. Huffman. 1990. "Solid C60: A new form of Carbon." *Nature*, 347, 354.

Kroto, Harold, Richard Smalley, and Robert Curl. 1985. C60: Buckminsterfullerene. *Nature*. **318**:162.14 November.

Kuhn, Thomas S. 1970. *The Structure of Scientific Revolutions*. Second Enlarged Edition. University of Chicago Press.

Kump, Lee, James Kasting, and Robert Crane. 2003. *The Earth System*. Second Edition. CHIPS Environmental Science Books. Waco, Texas.

Kurzweil, Ray. 1999. *The Age of Spiritual Machines: When Computers Exceed Human Intelligence*. N.Y.: Viking.

Kvenvolden, K., J. Lawless, K. Pering, E. Peterson, J. Flores, C. Ponnampereuma, I.R. Kaplan. C. Moore. 1970. Evidence for Extraterrestrial Amino-acids and Hydrocarbons in the Murchison Meteorite. *Nature*. **228**: 923 – 926.

Lack, David. 1953. "Darwin's Finches." *Scientific American*. April. 68.

Laing, R. 1976. Automaton introspection. *Journal of Computer and System Sciences*. **13**(2):172 – 183.

Lakoff, George with Mark Johnson. 1980. *Metaphors We Live By*. University of Chicago Press.

Lakoff, George and Mark Johnson. 1999. *Philosophy in the Flesh*. N.Y.: Basic Books.

Lakoff, George and Rafael E. Nunez. 2000. *Where Mathematics Comes From: How the Embodied Mind Brings Mathematics into Being*. N.Y.: Basic Books.

Lamarck, J.B. 1984[1809]. *Zoological Philosophy: An Exposition with regard to the Natural History of Animals*. With the Eulogy by Georges Cuvier. trans. Hugh Elliot. University of Chicago Press.

\_\_\_\_\_. 1817. "Homme." In *Nouveau dictionnaire d'histoire naturelle*. New Ed. Paris: Déterville **15**:271.

Langton, Christopher. 1989. *Artificial Life*. Redwood, CA: Addison-Wesley.

Langton, C.J. 1992. "Life at the edge of Chaos." *Artificial Life II*.

Latour, Bruno and Steve Woolgar. 1979. *Laboratory Life: The Social Construction of Scientific Facts*. London: Sage.

Laudan, Larry. 1990. *Science and Relativism*.

Lawson, Hilary and Lisa Appignanesi eds. 1989. *Dismantling Truth: Reality in the Post-Modern World*. London: Weidenfeld and Nicholson.

Lazcano, A. and S. L. Miller. 1994. "How long did it take for life to begin and evolve to cyanobacteria?" *J. Mol. Evol.* **39**:546 – 554.

Lecar, Myron and Dimitar Sasselov. 2003. Planetary survivor strategy: Outeat, outweigh, outlast! Harvard-Smithsonian Center for Astrophysics. December 29. *The Astrophysical Journal Letters*. October 10.

Lee, D. H., J. R. Cranja, J. A. Martinez, K. Severin, and M.R. Ghadiri. 1996. "A self-replicating peptide." *Nature* **382**:525 – 528.

Lee, D., K. Severin, Y. Yokobayashi, and M.R. Ghadiri. 1997. "Emergence of symbiosis in peptide self-replication through a hypercyclic network." *Nature* **390**:591 – 594.

Lenoir, Tim. 1982. *The Strategy of Life: Teleology and Mechanics in Nineteenth Century German Biology*. Dordrecht, Netherlands: Reidel.

Lenski, Richard E., Charles Ofria, Robert T. Pennock and Christoph Adami. 2003. The evolutionary origin of complex features. *Nature* **423**. 139-144. May 8.

Lenski, R. E. 2006. E. coli as a model organism in evolutionary genetics. in C.W. Fox and J.B. Wolf, eds. *Evolutionary Genetics: Concepts and Case Studies*. Oxford University Press: New York. 485 – 487.

Lenski, R.E., J.E. Barrick, and C. Ofria. 2006. Balancing robustness and evolvability. *PLoS Biology* **4**: e428.

Lerena, P. 2000. Mate Choice: simple or Complex? *Artificial Life VII*.

Lerman, Louis, Jacqueline Teng. *In the Beginning: A Functional First Principles Approach to Chemical Evolution*. Undated Report produced on work performed at UC Berkeley.

Lerman, Louis, Jacqueline Teng, and Sarah Kuwabara. 2004. Chemical Evolution on an Early Mars: Existence of a Planetary-Scale Infrastructure. Prebiotic Chemistry & Origin of Life. Third Astrobiology Conference. Mar 27. NASA Ames Research Center.

- Lerman, Louis. 1993. Bubble Genesis of Life. *Science*. July 9.  
<http://www.lbl.gov/Science-Articles/Archive/bubble-genesis-of-life.html>
- Letelier, Juan-Carlos, Jorge Soto-Andrade, Flavio Guíñez-Abarzua, Athel Cornish-Bowden and María Luz Cãrednas. 2004. "Metabolic Closure in (M,R) systems." *Artificial Life IX*.
- Lewin, R. 1992. *Complexity: Life at the Edge of Chaos*. NY: Macmillan.
- Lifson, S. 1997. "On the crucial stages in the origin of animate matter." *L. Mol. Evol.* **44**:1 – 8.
- Lindahl, B I B. 1997. Consciousness and biological evolution. *Journal of Theoretical Biology*. **187**:613-629
- Lipson, Hod and Jordan Pollack. 2000. "Evolving Physical Structures." *Artificial Life VII*.  
<http://www.demo.cs.brandeis.edu/golem>
- López-García P, Moreira D. 1999. Metabolic symbiosis at the origin of eukaryotes. *Trends in Biochemical Sciences*. **24** (3): 88-93.
- Lorenz, Konrad. 1977. *Behind the Mirror: a search for the natural history of human knowledge*, translated by Ronald Taylor, London: Methuen and Company Ltd.
- Lovejoy, Arthur O. *The Great Chain of Being: A Study of the History of an Idea*. Cambridge, MA: Harvard University Press. 1936.
- Lovelace, Mary Caroline, Countess of (Ada Augusta). 1842. "Translator's Notes to an Article on Babbage's Analytical Engine." *Scientific Memoirs*. R. Taylor, Ed. 3. 691 – 731.
- Lovelock, J. E. 1972. Gaia as seen through the atmosphere. *Atmos. Environ.* **6**: 579 – 580.
- Lovelock, J. 1979. *Gaia: A New Look at Life on Earth*. Oxford University Press.
- \_\_\_\_\_. 1995. *The Ages of Gaia: A Biography of Our Living Earth*. Oxford University Press.
- Lovelock, J. and L. Margulis. 1974. Atmospheric homeostasis by and for the biosphere: the Gaia hypothesis. *Tellus*. **26**:2 – 10.
- Lovelock, J. and Watson, A.J. 1983. Biological homeostasis of the global environment: the parable of Daisyworld. *Tellus*. **35B**:284-289.
- Luisi, Pier Luigi. 2006. *The Emergence of Life. From Chemical Origins to Synthetic Biology*. Cambridge University Press, Cambridge.
- Luria, Salvator E. 1959. in *Virus Growth and Variation*. Editors. A. Isaacs and B.W. Lacey. Cambridge University Press. 1 – 10.
- Lyell, Charles. 1909 – 14. "II. Uniformity Of Change." *Scientific Papers*. The Harvard Classics.
- Maes, Patti. Editor. 1991. *Designing Autonomous Agents: Theory and Practice from Biology to Engineering and Back*. M.I.T. Press.

Margolis, E. Eric and Stephen Laurence. 1999. *Concepts: Core Readings*. Cambridge, MA: MIT Press.

Margulis, Lynn [Sagan, Lynn]. 1967. "On the origin of mitosing cells." *J. Theoretical Biology* **14**(3):255 – 74.

\_\_\_\_\_. 1975. Symbiotic theory of the origin of eukaryotic organelles: criteria for proof. *Symp. Soc. Exp. Biol.* **29**:21-37.

Margulis, Lynn. 1981. *Symbiosis and Cell Evolution*. First Edition. San Francisco: Freeman.

\_\_\_\_\_. 1993. *Symbiosis and Cell Evolution*. Second Edition. San Francisco: Freeman.

Margulis, Lynn, Dorion Sagan. 1986. *Microcosmos*. Summit Books. New York.

\_\_\_\_\_. 1997. *Slanted Truths: Essays on Gaia, Symbiosis, and Evolution*. N.Y.: Springer-Verlag.

\_\_\_\_\_. 2002. *Acquiring Genomes: A Theory of the Origins of Species*. N.Y.: Basic Books.

Margulis, Lynn, Michael F. Dolan, and Ricardo Guerrero. 2000. The chimeric eukaryote: Origin of the nucleus from the karyomastigont in amitochondriate protists. *Proceedings of the National Academy of Sciences (PNAS)*. **97**:13. June 20. 6954 – 6959.

Martin W. and Müller M. 1998. "The hydrogen hypothesis for the first eukaryote." *Nature* **392**. March 5. 6671: 37-41.

Mattiussi, Claudio and Dario Floreano. 2004. "Connecting Transistors and Proteins." *Artificial Life IX*.

Maturana, H. R. 1970. *Biology of Cognition*, University of Illinois, Urbana, Illinois.

Mayr, Ernst. 1976. "Accident or Design: The Paradox of Evolution" in *Evolution and the Diversity of Nature*, Harvard University Press. 30-43.

Maynard Smith, John. 1986. *The Problems of Biology*. Oxford University Press.

Maynard Smith, John and Eørs Szathmary. 1995. *The Major Transitions in Evolution*. Oxford University Press.

\_\_\_\_\_. 1999. *The Origins of Life: from the birth of life to the origins of language*. Oxford University Press.

Mayr, Ernst. 1976. *Evolution and the Diversity of Life: Selected Essays*. Cambridge, MA: Belknap Division of Harvard University Press. Accident or Design: The Paradox of Evolution. 30 – 43.

\_\_\_\_\_. 1982. *The Growth of Biological Thought: Diversity, Evolution, and Inheritance*. Cambridge, MA: Belknap Division of Harvard University Press.

\_\_\_\_\_. 1988. *Toward a New Philosophy of Biology: Observations of an Evolutionist*. Cambridge, MA: The Belknap Press.

McKay, C.P. 1996. Oxygen and the rapid evolution of life on Mars, In *Chemical Evolution: Physics of the Origin and Evolution of Life*. Edited by J. Chela-Flores and F. Raulin, Kluwer, 177 – 184.

McKay, C.P. 1997. “The search for life on Mars.” *Origins Life Evol. Biosphere*. **27**:263-289.

McKay, D.S. et al. 1996. “Search for Past Life on Mars: Possible Relic Biogenic Activity in Martian Meteorite ALH84001.” *Science* **273**. 924-930.

McKay, D.S. et al. 1999. “Possible Bacteria in Nakhla” [#1 816], Proceedings of the 30th Lunar & Planetary Science Conference. Houston, Texas. March 15 – 19.

<http://www.jpl.nasa.gov/snc/alh.html>

McLaughlin, P. 1990. *Kant's Critique of Teleology in Biological Explanation*. Lampeter: Edwin Mellen Press.

McLaughlin, A. 2000. Discussion of *Beneath the Surface: Critical Essays in the Philosophy of Deep Ecology*, edited by Eric Katz, Andrew Light, and David Rothenberg (Cambridge: MIT Press, 2000). American Philosophical Association, Society for Philosophy and Technology, Dec. 28, 2000. <http://www.deep-ecology.net/writing/mclaughlin.html>

Medler, David A. 1998. A brief history of connectionism. *Neural Computing Surveys*. 1(2): 18 – 72. Also in: *Neural Computing Surveys*. 1:61 – 101.

[On-line serial], <http://www.icsi.berkeley.edu/~jagota/NCS/vol1.html>

Michod, Richard E. and Denis Roze. 2000. A Multi-level Selection Theory of Evolutionary Transitions in Individuality. *Artificial Life 7 Workshop Proceedings*.

Miller, S.L. 1953. A production of amino acids under possible primitive earth conditions. *Science* **117**: 528 – 529.

Miller, Stanley L. and Leslie E. Orgel. 1974. *The Origins of Life on the Earth*. NY: Prentice-Hall.

Miller, Stanley L. and Harold C. Urey. 1959. Organic Compound Synthesis on the Primitive Earth. *Science*. **130**: 245 – 251.

Mills, Susan and John Beatty. 1983. “The Propensity Interpretation of Fitness.” *Conceptual Issues in Evolutionary Biology*, ed. Elliott Sober, M.I.T. Press. 36 – 57.

Minsky, Marvin. 1985. *A Society of Mind*. New York: Simon and Schuster.

Mitchell, M. 1993. *Analogy-Making as Perception: A Computer Model*. Cambridge, MA: MIT Press.

Mitchell, M. 2001. Analogy-making as a complex adaptive system. In L. Segel and I. Cohen (editors), *Design Principles for the Immune System and Other Distributed Autonomous Systems*. New York: Oxford University Press.

Mitchell, M. 2005. Self-awareness and control in decentralized systems. In Working Papers of the AAAI 2005 Spring Symposium on Metacognition in Computation. Menlo Park, CA: AAAI Press.

Mitchell, P. 1961. *Nature* (London) 191. 144 – 148.

Mitchell, P. 1966. Chemiosmotic Coupling in Oxidative and Photosynthetic Phosphorylation, Glynn Research, Bodmin.

Mitchell, P. 1968. Chemiosmotic Coupling and Energy Transduction, Glynn Research, Bodmin.

Michie, Donald. 1970. Ed. *Machine Intelligence*. 5. Edinburgh U. Press, Communications of the ACM.

Minsky, Marvin. 1974. A Framework for Representing Knowledge. MIT-AI Laboratory Memo 306, June. Reprinted in *The Psychology of Computer Vision*, P. Winston (Ed.), McGraw-Hill, 1975. Shorter versions in J. Haugeland, Ed., *Mind Design*, MIT Press, 1981, and in *Cognitive Science*, Collins, Allan and Edward E. Smith (eds.) Morgan-Kaufmann, 1992.

Minsky, Marvin. *The Society of Mind*. New York: Simon and Schuster, 1986.

Miyakawa, Shin H. James Cleaves, and Stanley Miller. 2002. The Cold Origin of Life: Nucleic Acid Bases Produced from Frozen HCN Solutions. #78. ISSOL 2002.

Monnard, P.-A., Apel, C.L., Kanavarioti, A., Deamer, D.W., 2002. Influence of ionic inorganic solutes on self-assembly and polymerization processes related to early forms of life: Implications for a prebiotic aqueous medium, *Astrobiology*. 2:139 – 152.

Monod, Jacques. 1971. *Chance and Necessity*. translated by A. Wainhouse. N.Y.: Knopf.

Montagu, Ashley. Ed. 1984. *Science and Creationism*. Oxford University Press.

Morey-Holton, E. 2002. *Gravity shapes life in Evolution on Planet Earth: The impact of the Physical Environment*. Ed. L. Rothschild and A. Lister. NY: Academic Press.

Morowitz, Harold J. 1985. *Mayonnaise and the Origins of Life: Thoughts of Minds and Molecules*. N.Y.: Charles Scribner's Sons.

\_\_\_\_\_. 1987. *Cosmic Joy and Local Pain: Musings of a Mystic Scientist*. N.Y.: Charles Scribner's Sons.

\_\_\_\_\_. 1992. *The Beginnings of Cellular Life*. New Haven, CT: Yale University Press.

\_\_\_\_\_. 2001. The Epistemic Paradox of Mind and Matter. *Annals of the New York Academy of Sciences* 929:50 – 54 (2001)

\_\_\_\_\_. 2002. *The Emergence of Everything*. Oxford University Press.

Morowitz, Harold J., Bettina Heinz, and David Deamer. 1988. The Chemical Logic of a Minimum Protocell. *Origins of Life and Evolution of the Biosphere*. 18: 281 – 287.

Mytilinaios, Efstathios, Mark Desnoyer, David Marcus, and Hod Lipson. 2004. "Designed and Evolved Blueprints for Physical Self-Replicating Machines." *Artificial Life IX*.

Nahin, P. J. 1988. "Kelvin's Cooling Sphere: Heat Transfer Theory in the 19th Century Debate over the Age-of-the-Earth" in *History of Heat Transfer: Essays in Honor of the 50th Anniversary of the ASME Heat Transfer Division* (E. T. Layton and J. H. Lienhard, Eds.). New York: ASME. 65 – 85.

National Research Council Report. 1998.

Naveh, Barak, Moshe Sipper, Doron Lancet and Barak Shenhav. 2004. "Lipidia: An Artificial Chemistry of Self-Replicating Assemblies of Lipid-like Molecules." *Artificial Life IX*.

Navarro-Gonzalez, Rafael, Christopher McKay, and Paola Molina. 2002. Organic Content of the Atacama Desert Soils Along the North to South Gradient. #59. ISSOL.

Neumann, John von. 1966. in A. Burks: *Theory of Self-Reproducing Automata*. Urbana, Illinois: University of Illinois Press.

New, Michael H. and Andrew Pohorille. 1999. An Inherited Efficiencies Model of Non-genomic Evolution. *DIMACS Workshop on Evolution as Computation*. January 11 – 12. Princeton University.

Newell, Allen. Learning, Generality and Problem Solving. IFIP Congress 1962: 407 – 412.

\_\_\_\_\_. 1969. Heuristic programming: Ill-structured problems in *Progress in Operations Research: Relationship Between Operations Research and the Computer*. J. Aronofsky, Ed., vol. 3. New York: John Wiley & Sons. 360 – 413.

Nii, H. Penny. "Blackboard Systems." *The Handbook of Artificial Intelligence*. Vol. IV Editors: Avron Barr, Paul R. Cohen and Edward A. Feigenbaum. Addison-Wesley Publishing Company Inc. 1989. 6-69.

Noble, Jason and Manuel de Pinedo. 2004. Mechanistic and ecological explanations in agent-based models of cognition in: Pollack, J, Bedau, M, Husbands, P, Ikegami, T & Watson, R A (editors) *Artificial Life IX Proceedings of the Ninth International Conference on the Simulation and Synthesis of Living Systems*. MIT Press / Bradford Books. 528 – 533.

Noller, Harry F. 1999. On the Origin of the Ribosome: Coevolution of Subdomains of tRNA and rRNA. *The RNA World*. Second Edition. Cold Spring Harbor Laboratory Press.

Nowak M. and P. Schuster. 1989. Error thresholds of replication in finite populations. Mutation frequencies and the onset of mullers ratchet. *Journal of Theoretical Biology*. **137**: 375 – 395.

Nowak M.A., R.M. May. 1992. Evolutionary games and spatial chaos. *Nature*. **359**: 826 – 829.

Nowak M. and K. Sigmund. 1989. Oscillations in the evolution of reciprocity. *Journal of Theoretical Biology*. **137**: 21 – 26.

\_\_\_\_\_. 1993. A strategy of win-stay, lose-shift that outperforms tit for tat in Prisoner's Dilemma. *Nature*. **364**: 56 – 58.

\_\_\_\_\_. 1993. Chaos and the evolution of cooperation. *Proceedings of the National Acad Sci USA* **90**: 5091 – 5094.

Nowak MA, S Bonhoeffer, RM May. 1996. Robustness of cooperation. *Nature* **379**: 125 – 126

Nowak M.A. 2004. Prisoners of the Dilemma. *Nature* **427**: 491.

Nowak M A, May R M, Sigmund K. 1995. The arithmetics of mutual help, *Scientific American*, 272 (June 1995), 76-81.

Nowak M A (2000) Homo grammaticus, *Natural History*, **109**. 36-44.

Oberbeck, V. R. and Fogelman, G. 1989. *Origins Life Evol. Biosphere* **19**, 549.

\_\_\_\_\_. 1990. *Origins Life Evol. Biosphere* **20**, 181.

Ofria, Charles and Christoph Adami. 1999. “Evolution of Genetic Organization in Digital Organisms.” *DIMACS Workshop on Evolution as Computation*. January 11 – 12. Princeton University.

Olsson, Lars, Chrystopher L. Nehaniv, and Daniel Polani. 2004. “Information Trade-offs and the Evolution of Sensory Layouts.” *Artificial Life IX*.

Oparin, A.I. 1957 [1936]. *The Origin of Life on the Earth*. Edinburgh: Oliver & Boyd.

Oparin, A.I. 1964 [1924]. *The Chemical Origin of Life*. Trans. Anne Synge. Fort Lauderdale, FL: Thomas Books.

\_\_\_\_\_. 1994 [1924]. *The Origin of Life*. Reprinted in David Deamer, Gail Fleischaker. *Origins of Life: The Central Concepts*. Boston: Jones and Bartlett.

Orgel, Leslie E. 1963. The Maintenance of the Accuracy of Protein Synthesis and its Relevance to Ageing. *Proc Natl. Acad. Sci. USA*. **49**:517 – 521.

Orgel, Leslie E. 1973. *The Origins of Life: Molecules and Natural Selection*. N.Y.: John Wiley and Sons.

\_\_\_\_\_. 1979. Selection *in vitro*. *Proceedings of the Royal Society of London*. **B205**: 435 – 442.

\_\_\_\_\_. 1994. The Origin of Life on Earth. *Scientific American*. Volume 271, Number 4. October. 53 – 61.

Øztürkeri, Can and Mathieu S. Capcarrere. “Emergent Robustness and Self-Repair through Developmental Cellular Systems.” *Artificial Life IX*.

Packard, Alpheus S. 1901. *Lamarck, the Founder of Evolution: His Life and Work* with translations of his writings on organic evolution. N.Y.: Longmans, Green, and Co.

Pagels, Heinz. 1988. *The Dreams of Reason: The Computer and the Rise of the Sciences of Complexity*. N. Y. Simon and Schuster.

Pargellis, A.N. 1996. The evolution of self-replicating computer organisms. *Physica D* 98. April. 111 – 127.

Pargellis, Andrew N., Bernard Yurke. 2000. Spontaneous Generation and Colony Formation in the Amoeba World. *Artificial Life 7 Workshop Proceedings*.

Pargellis, Andrew. 2001. Digital Life Behavior in the Amoeba World in *Artificial Life 7*:1 Winter.

Pasteur, Louis. 1861. “On the Organized Corpuscles that Exist in the Atmosphere” *Annals de Sciences naturelles in Oeuvres*. Ed. Pasteur Vallery-Radot. Paris: Masson et Cie.

Pattee, H. H. 1995a. “Artificial Life Needs a Real Epistemology.” In F. Moran et al. Editors. *Advances in Artificial Life*. Berlin: Springer. 23 – 38.

Pattee, H.H. 1995b. Evolving Self-Reference: Matter, symbols, and semantic closure. *Communication and Cognition. Artificial Intelligence* 12 (1-2):9 – 28.

Pendleton, Y.J., S.A. Sandford; L.J. Allamandola; A.G.G.M. Tielens; K. Sellgren. 1994. “Near-infrared absorption spectroscopy of interstellar hydrocarbon grains.” *Astrophysical Journal*. **437** no.2:683 – 696

Peirce, Charles Sanders. 1934. *Collected Papers of Charles Sanders Peirce, vol. 5*. Ed. Charles Hartshorne and Paul Weiss. Harvard University Press.

\_\_\_\_\_. 1955. *Philosophical Writings of Peirce*. Ed. Justus Buchler. N.Y.: Dover.

Piaget, Jean. 1985. *The Equilibration of Cognitive Structures: The Central Problem of Intellectual Development*, translated by Terrance Brown and Kishore Julian Thampy. Chicago, IL: University of Chicago Press.

Pietsch, Theodore and W. Grobecker. 1978. The Compleat Angler: Aggressive Mimicry in an Antennarid Anglerfish. *Science*. **201**.

Pigliucci, Massimo. Phenotypic Integration. 2003. A collection of technical essays on the evolution of complex biological organs. Oxford University Press.

Pigliucci, Massimo and Jonathan Kaplan. 2006. Making Sense of Evolution: A philosophical examination of the fundamental concepts of evolutionary theory and practice. Chicago University Press.

Pirie, N. W. 1937. “The meaninglessness of the terms life and living.” In J. Needham and D. E. Green, *Perspectives in Biochemistry*. Cambridge University Press, Cambridge.

Planck, Max. 1932. *Where Is Science Going?*, trans. J. Murphy. N.Y.: W.W. Norton and Co.

Plasson, Hughes Bersini and Auguste Commeyras. 2004. “Homochirality as Fixed Point of Prebiotic Chemistry.” *Artificial Life IX*.

Pohorille, A. and Wilson. 1994. Interaction of a model peptide with a water-bilayer system. in *Structure and Reactivity in Aqueous Solution: Characterization of Chemical and Biological*

Systems, Cramer, C.; Truhlar, D., Eds., ACS Symposium Series No. 568. ACS, Washington D.C., 11: 395.

Pohorille, A. and M.A. Wilson. 1993. Molecular dynamics studies of simple membrane — Water interfaces: Structure and functions in the beginnings of cellular life. *Journal of the Origins of Life and Evolution of Biospheres*. Volume 25, Numbers 1-3 / June, 1995. 21.

Poincaré, H. Chance. 1988. In J. Newman Ed. *The World of Mathematics* vol. 2. Redman, WA: Tempus. 1359-72.

Poole, Anthony M. 2002. “What is LUCA?” American Institute of Biological Sciences.

Poole AM. and Penny D. (2007). Evaluating hypotheses for the origin of eukaryotes. *Bioessays* **29** (1): 74-84.

Popper, Karl Raimond. [1935] 1959. *The Logic of Scientific Discovery*. London: Hutchinson.

\_\_\_\_\_. 1963. *Conjectures and Refutations*. London: Routledge.

\_\_\_\_\_. 1966. *Of Clouds and Clocks: An Approach to the Problem of Rationality and the Freedom of Man*, The Compton Memorial Lecture presented at Washington University. April 21, 1965. Washington University Press.

Prigogine, I. and I. Stengers. 1989. *Order Out of Chaos: Man's New Dialog with Nature*. N.Y.: Bantam Doubleday.

Popa, Radu. 2004. *Between Necessity and Probability: Searching for the Definition and Origin of Life*. NY.: Springer.

Rapoport, Anatol. 1991. Ideological commitments in evolutionary theories. *Journal of Social Issues*. Issues in Evolutionary Psychology. 47. **3**: 83 – 100. Fall.

Rasmussen, Steen, Carsten Knudsen, Pasmus Feldberg, Morten Hindsholm. 1990. The coreworld: emergence and evolution of cooperative structures in a computational chemistry. *Proceedings of the ninth annual international conference of the Center for Nonlinear Studies on Self-organizing, Collective, and Cooperative Phenomena in Natural and Artificial Computing Networks on Emergent Computation*. North-Holland Publishing Co.

Rasmussen, S. L. Chen, N. Nilsson, and S. Abe. 2003. Bridging living and non-living matter. *Artificial Life*. **9**:269-316.

Ray, Tom. 1992. An Approach to the Synthesis of Life. *Artificial Life II*. Ed. C. Langton, C. Taylor, J. D. Farmer, and S. Rasmussen. Addison-Wesley. Evolution and Complexity. *Complexity: Metaphors, Models, and Reality*. Ed. G. Cowan, d. Pines, D. Meltzer. Santa Fe: Addison Wesley.

Ray, Thomas S. 2003. An evolutionary approach to synthetic biology: zen in the art of creating life. *Advances in evolutionary computing: theory and applications*. NY: Springer-Verlag.

Ray, Thomas S. and Joseph F. Hart. 2000. Evolution of differentiation in Multithreaded Digital Organisms. *Artificial Life VII*.

Reichenbach, Hans. 1951. *The Logic of Scientific Discovery*, Berkeley: University of California Press.

Reil, Torsten. 2000. Models of Gene Regulation – A Review. *Artificial Life 7 Workshop Proceedings*.

REPAST Toolkit. 2007. <http://repast.sourceforge.net/>

Ridley, Mark. *The Cooperative Gene*. New York: The Free Press/ Simon and Schuster. 2001.

Rocha, L. M., Editor. 2001. “The Physics and Evolution of Symbols and Codes: Reflections on the Work of Howard Pattee.” Special issue of *BioSystems*. 60 (1 – 3).

Rocha, Luis Mateus. 2004. “Evolving Memory: Logical Tasks for Cellular Automata.” *Artificial Life IX*.

Rodin, Sergei N. and Arthur D. Riggs. 2002. Epigenetic Silencing May Aid Evolution by Gene Duplication. #123. ISSOL.

Roll-Hansen, N. 1983. “The death of spontaneous generation and the birth of the gene: two case studies of relativism.” *Social Studies of Science*. 13:481 – 519.

Ronald, M., M. Sipper, and M.S. Cascarrere. Testing for Emergence in Artificial Life. *Advances in Artificial Life*. 13 – 20. Springer. 1999.

Rosen, R. 1958a. A relational theory of biological systems. *Bull. Math. Biophys.* 20:245 – 317.

\_\_\_\_\_. 1958b. The representation of biological systems from the standpoint of the theory of categories. *Bull. Math. Biophys.* 20:317 – 341.

\_\_\_\_\_. 1959. A relational theory of biological systems II. *Bull. Math. Biophys.* 21:109 – 128.

\_\_\_\_\_. 1972. Some relational cell models: The metabolism-repair system. In Rosen, R. Editor. *Foundations of Mathematical Biology*. New York: Academic Press.

\_\_\_\_\_. 1991. *Life Itself*. New York: Columbia University Press.

\_\_\_\_\_. 2000. *Essays on Life Itself*. New York: Columbia University Press.

Ruiz-Mirazo, Pedro, Juli G. Pereto, and Alvaro Moreno. 2002. Proposal for a Universal Definition of Life. ISSOL 2002.

Ruse, Michael. 1999. *Mystery of Mysteries: Is Evolution a Social Construction?* Harvard University Press.

\_\_\_\_\_. 2000. *The Evolution Wars: A Guide to Debates*. ACB-CLIO Inc. Santa Barbara, CA.

\_\_\_\_\_. 2003. *Darwin and Design*. Harvard University Press.

- Russell, Stuart and Peter Norvig. Eds. 2003. *Artificial Intelligence: A Modern Approach*. (Second Edition). N.J.: Prentice Hall.
- Sagan, Carl. 1974. *The UFO's: A Scientific Debate*. N.Y.: W.W. Norton and Company.
- \_\_\_\_\_. 1985. *Contact*. N.Y.: Simon and Schuster.
- \_\_\_\_\_. 1987. "The Burden of Skepticism" first published in *Skeptical Inquirer*. 12. Fall.
- \_\_\_\_\_. 1998. "Life." *The New Encyclopedia Britannica*. vol 22. Macropaedia. 15<sup>th</sup> edition.
- Sahtouris, Elisabet. 1999. *Earthdance: Living Systems in Evolution*. <http://www.ratical.org/LifeWeb/Erthdnce/erthdnce.html>
- Salzberg, Chris, Hiroki Sayama and Takashi Ikegami. 2004. "A Tangled Hierarchy of Graph-Constructing Graphs." *Artificial Life IX*.
- Sandford, S. A., M. P. Bernstein, & J. P. Dworkin, 2001. Assessment of the Interstellar Processes Leading to Deuterium Enrichment in Meteoritic Organics *Meteoritics and Planetary Science*, **36**:1117 – 1133.
- Sasselov, Dimitar. Deconstructing Life: Interview with Dimitar Sasselov. *Astrobiology Magazine*. March 13, 2006.
- Scheffler, Israel. 1963. *The Anatomy of Inquiry: Philosophical Studies in the Theory of Science*, N.Y.: Alfred A. Knopf.
- Carl D. Schlichting and Massimo Pigliucci. 1998. Phenotypic Evolution: A Reaction Norm Perspective. Sunderland, MA: Sinauer Associates Publishers.
- Schopf, J.W., and Packer, B.M., 1987, Early Archean (3.3-billion-to 3.5-billion-year old) microfossils from the Warrawoona Group, Australia. *Science*. **237**:70 – 73.
- Schopf, J.W. Ed. *Earth's Earliest Biosphere*. Princeton University Press. 1983. 240 – 259.
- \_\_\_\_\_. 2002a. "Life." *The New Encyclopedia Britannica*. vol 22. Macropaedia. 15<sup>th</sup> edition. *Nature*, March 7:73 – 81.
- \_\_\_\_\_. 2002b. Schopf vs Brasier Debate. ISSOL.
- Schopf, J. W. 2002. Ed. *The Beginnings of Biological Organization*. Berkeley, California. University of California Press.
- Schrödinger, Erwin. 1922. *What is Natural Law?* Inaugural Address delivered at the University of Zurich, December.
- \_\_\_\_\_. 1967 [1944]. *What is Life?* Cambridge University Press.
- Schuster, Peter and Walter Fontana. 1999. "Chance and necessity in evolution: lessons from RNA." *Physica D*. **133**. 427 – 453.

- Selfridge, Oliver. 1959. Pandemonium: A paradigm for learning. In *Symposium on the mechanization of thought processes*. London: HM Stationary Office.
- Shapiro, Robert. 1987. *Origins: A Skeptic's Guide to the Creation of Life on Earth*. N.Y.: Bantam Books.
- Shenhav, Barak, Ran Kafri, and Doron Lancet. 2004. Graded Artificial Chemistry in Restricted Boundaries based on the GARD (Graded Autocatalysis Replication Domain model). *Artificial Life IX*.
- Sherrington, Sir Charles. 1951[1937-8]. *Man on His Nature*. Gifford Lectures. Cambridge University Press.
- Siefert, J. and J. Kasting. 2002. "The Complicated History of a Promiscuous Operon." #22. ISSOL.
- Sigmund K., E. Fehr, M A. Nowak. 2002. The economics of fair play. *Scientific American*. **286**: 82 – 87.
- Silverman, E. and Bullock, S. 2004. Empiricism in artificial life. In Pollack, J., Bedau, M, Takashi Ikegami, P. H. and Watson, R. A., Eds. *Proceedings of the Ninth International Conference on Artificial Life*. 534 – 539.
- Simon, H. A. Essay "The Architecture of Complexity." Proceedings of the American Philosophical Society. **106**(6). 467 – 482.
- Simon, H. A. 1998. *The Sciences of the Artificial*. Cambridge: M.I.T. Press.
- Simonton, Dean Keith. 1988. *Scientific Genius: A Psychology of Science*. Cambridge University Press.
- \_\_\_\_\_. 1984. *Genius, Creativity, & Leadership: Historiometric Inquiries*. Harvard University Press.
- Sipper, Moshe. 1994. "Fifty Years of Research on Self Replication: An Overview." *Artificial Life IV*.
- The Artificial Self-Replication Page*. <http://www.cs.bgu.ac.il/~sipper/selfrep/> (Oct, 11, 2006)
- \_\_\_\_\_. 1997. *Evolution of Parallel Cellular Machines: The Cellular Programming Approach*, Heidelberg: Springer-Verlag.
- \_\_\_\_\_. 2002. *Machine Nature: The Coming Age of Bio-Inspired Computing*, N.Y: McGraw-Hill.
- Sipper, M. and J. A. Reggia. 2001. "Go forth and replicate." *Scientific American*. **285**. 2. 26 – 35. August.
- Smil, Vaclav. 1997. *Cycles of Life: Civilization and the Biosphere*. NY: Scientific American Library.

Smith, Adam. 1790 [1759]. Sixth edition. *The Theory of Moral Sentiments*. London: A. Millar.  
<http://www.econlib.org/library/Smith/smMS.html>

Smith, J. Maynard. 1975. *The Theory of Evolution*, 3rd Edition. Penguin.

Smith, J. Maynard and Eors Szathmary. 2000. *The Origins of Life: from the birth of life to the origins of language*. Oxford University Press.

Smolin, Lee. 1997. *The Life of the Cosmos*. Oxford University Press.

Snelson, Kenneth. 1965. First patent on the tensegrity principle he discovered: Discontinuous Compression Structures. Patent #3,169,611. February.

Snow, C.P. 1993 [1959]. *The Two Cultures*. Cambridge University Press.

Sober, Elliott. 1983. "Holism, Individualism, and the Units of Selection." *Conceptual Issues in Evolutionary Biology*, ed. Elliott Sober, M.I.T. Press.

Solé, Ricardo and Brian Goodwin. 2000. *Signs of Life: How Complexity Pervades Biology*. N.Y.: Basic Books.

Spencer, Herbert. 1864. *Principles of Biology*. 2 vols. London: Williams and Norgate.

Spronsen J.W. von. 1969. *The Periodic Table of Elements: A History of the First hundred Years*. Amsterdam: Elsevier.

Stadler, B. M. R., P. F. Stadler, G. Wagner and W. Fontana. 2001. The topology of the possible: Formal spaces underlying patterns of evolutionary change. *Journal of Theoretical Biology*. 213 (2), 241-274.

Stauffer, Andre and Moshe Sipper. 2002. "Interactive Self-Replicating, Self-Incrementing and Self-Decrementing Loops." *Alife VIII*.

Steele, A. et al. 2000. "The Microbiological Contamination of Meteorites: A Null Hypothesis" [#1670]. Proceedings. 31st Lunar and Planetary Science Conference. Houston, Texas. March 13 – 17.

Steels, Luc. 1994. Building Agents out of Autonomous Behavior Systems.  
<http://arti.vub.ac.be/~steels/>

Stevens, T.O. and J.P. McKinley. 1995. "SLiME" (Subsurface Lithoautotrophic Microbial System). *Science*. October 20. **270**:450 – 454.

Stiemerling, Oliver and Armin B. Cremers. 2000. A Paleontological Perspective on Designing Adaptable Software Systems in *Artificial Life 7 Workshop Proceedings*.

Suzuki, H. 2000. Evolvability Analysis: Distribution of Hyperblobs in a Variable-Length Protein Genotype Space. *Artificial Life VII*.

Szathmary, E., and L. Demeter. 1987. Group selection of early replicators and the origin of life. *J. Theor. Biol.* **128**:463 – 486.

- Szilard, Leo. 1978. *Leo Szilard: His Version of the Facts - Selected Recollections and Correspondence*. Spencer R. Weart and Gertrud Weiss Szilard, editors. Cambridge Massachusetts: M.I.T. Press.
- Szostak, J. and A.D. Ellington. 1993. "In vitro selection of functional RNA sequences." In R.F. Gesteland and J.F. Atkins Editors. *The RNA World*. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press. 511 – 533.
- Szostak J.W. 1999. Constraints on the sizes of the earliest cells. In, 'Size Limits of Very Small Microorganisms', *Proceedings of a Workshop of the Space Studies Board*, National Research Council. National Academy Press.
- Szostak, J. W., D. P. Bartel, and P.L. Luisi. 2001. "Synthesizing Life." *Nature*. **409**:387 – 390.
- Tanford, Charles. 1978. The hydrophobic effect and the organization of living matter. *Science*. **200** (4345):1012 – 1018.
- Tateson, Richard. 2000. Genetic Regulatory Networks for Novel Computational Techniques. *Artificial Life 7 Workshop Proceedings*.
- Taylor, Tim. 2004. "Redrawing the Boundary between Organism and Environment." *Artificial Life IX*.
- Tenenbaum, David. 2003. "Earth's Oldest Fossils Reverse Course." *Astrobiology Magazine*. April 7.
- Thomas, Lewis. 1977. "At the Mercy of Our Own Defenses." *Earth's Answer: Explorations of Planetary Culture at the Lindisfarne Conferences*. Michael Katz, William P. Marsh, and Gail Gordon Thompson Eds. New York: Harper and Row.
- Thomson, W. (Lord Kelvin ). 1904. *Baltimore Lectures on Molecular Dynamics and the Wave Theory of Light*.
- Thompson, D'Arcy. 1961 [1917]. *On Growth and Form*. reissued (abridged) Cambridge University Press. Foreword by Stephen Jay Gould.
- Tononi, Giulio and Gerald M. Edelman. 1998. "Consciousness and Complexity." *Science*. 4 December. **282**: 1846 – 1851.
- Traulsen A and M.A. Nowak. 2006. Evolution of cooperation by multilevel selection. *Proceedings of the National Academy of Science USA* **103**: 10952 – 10955.
- Troland, Leonard. 1914. The chemical origin and regulation of life. *Monist* 24: 92 – 103.
- Turing, A.M. 1936 – 7. On computable numbers with an application to the entscheidungsproblem. *Proc. Lond. Math. Soc. Ser. 2*. **42**:230 – 265.
- \_\_\_\_\_. 1950. Computing, machinery, and intelligence. *Mind*. 51. 433 – 60. Reprinted in *Collected Works*.

\_\_\_\_\_. 1970 [1948]. *Intelligent Machinery*, report submitted to the National Physical Laboratory. first published in Donald Michie, Ed. *Machine Intelligence*. 5. Edinburgh U. Press Communications of the ACM. 21 – 23.

Turner, Scott. 2002. *The Extended Organism: The Physiology of Animal-Built Structures*. Harvard University Press.

\_\_\_\_\_. 2007. *The Tinkerer's Accomplice: How Design Emerges from Life Itself*. Harvard University Press.

Tweney, R. D., M. E. Doherty, and M. Mynatt. Editors. 1981. *On Scientific Thinking*. NY: Columbia University Press.

Urey, Harold C. 1952. On the early Chemical History of the Earth and the Origin of Life. *Proceedings of the National Academy of Sciences USA*. **38**: 351 – 363.

Varela, Francisco. 1979. *Principles of Biological Autonomy*. N.Y.: McGraw Hill/ Appleton Lange.

Venable, F.P. 1896. *The Development of the Periodic Law*. Easton, PA: Chemical Publishing.

Vernadsky V.I., 1945. The Biosphere and the Noosphere, *Scientific American*. **33**(1):1 – 12.

\_\_\_\_\_. 1986[1929] *The Biosphere* [abridged from 1929 edition]. London: Synergetic Press.

Wächterhäuser, Günter. 1988. Pyrite formation, the first energy source for life: A hypothesis. *Systematics and Applied Microbiology*. **10**:207 – 210.

\_\_\_\_\_. 1992. Groundwork for an evolutionary biochemistry: the iron-sulfur world.” *Prog. Biophys, Molec. Biol.* **58**:85 – 201.

Wächterhäuser, Günther. 1995. The Uses of Karl Popper in Laura Dassow Walls. *Seeing New Worlds: Henry David Thoreau and Nineteenth-Century Natural Science*. University of Wisconsin Press. 177 – 189.

Waddington, Conrad. 1957. *The Strategy of Genes*. London: Allen and Unwin.

\_\_\_\_\_. 1976. Evolution in the Sub-Human World in *Evolution and Consciousness*. Edited by Erich Jantsch and Conrad Waddington, Reading, MA: Addison Wesley.

\_\_\_\_\_. 1977. The Process Theory of Evolution and Notes on the Evolution of Mind in *Mind in Nature: Essays on the Interface of Science and Philosophy*. Washington, D.C.: University Press of America.

Wade, Michael. 2000. J. Interaction in Metapopulations: Effects on Adaptation and Diversity. *Artificial Life 7 Workshop Proceedings*.

Wald, George. 1954. The origin of life. *Scientific American* **191**:46.

\_\_\_\_\_. 1982. In *Horizons in Biochemistry*. Ed. M. Kasha ad B. Pullman. Academic Press. 127 – 142.

- Wallace, Alfred Russel. 1889. *Darwinism*. <http://www.gutenberg.org/etext/14558>
- \_\_\_\_\_. 1905. *My Life*. London: Chapman Hall. (online, Google Books)
- Ward, Peter D. and Donald Brownlee. 2000. *Rare Earth: Why Complex Life is Uncommon in the Universe*. NY: Springer-Verlag.
- Ward, Peter D. 2005. *Life as We Do Not Know It: The NASA Search for (and Synthesis of) Alien Life*. NY: Viking Penguin.
- Watson, A. and J. Lovelock. 1983. Biological homeostasis of the global environment: the parable of daisy-world. *Tellus*. **35B**:284 – 9.
- RA Watson and JB Pollack. 1999. “How Symbiosis Can Guide Evolution.” *Proceedings of the Fifth European Conference on Artificial Life*. Ed. D. Floreano, JD Nicoud, F. Mondale. Springer.
- Watson, R., T. Reil, J. Pollack. 2000. Mutualism, Parasitism, and Evolutionary Adaptation. *Artificial Life VII*.
- Watzlawick, Paul. 1984. *The Invented Reality*. N.Y.: W.W. Norton Company.
- Weiner, Jonathan. 1994. *The Beak of the Finch: A Story of Evolution in Our Time*. N.Y.: Alfred A. Knopf.
- Westall, Frances. 2002. “On the Earliest Diversity and Distribution of Early Archaean Life.” Javier Alcocer. ISSOL.
- Westheimer, F.H. 1987. Why Nature Chose Phosphates. *Science*. **235**:1173 – 1178.
- Wetherill, G. W. 1995. How special is Jupiter? *Nature*. **373**: 470.
- Wheeler, John Archibald, “Law Without Law,” in *Quantum Theory and Measurement*, ed. John Archibald Wheeler and Wojciech Hubert Zurek, Princeton Series in Physics (Princeton, NJ: Princeton University Press, 1983). 200-1.
- Wicken, J.S. 1987. *Evolution, Thermodynamics and Information*. N.Y.: Oxford University Press.
- Wicken, J.S. 1998. Evolution and Thermodynamics: The New Paradigm. *Systems Research and Behavioral Science*. **15**:365 – 372.
- Wilde, Simon A., John W. Valley, William H. Peck and Colin M. Graham. 2001. Evidence from detrital zircons for the existence of continental crust and oceans on the Earth 4.4 Gyr ago. *Nature*. January 11. 175.
- Wills, Christopher and Jeffrey Bada. 2000. *The Spark of Life: Darwin and the Primeval Soup*. Cambridge, MA: Perseus Books.
- Wills, Peter R. “Stepwise evolution of molecular biological coding.” 2004. *Artificial Life IX*.

- Wilson, E.O. 1995. *Naturalist*. N.Y.: Warner Books.
- \_\_\_\_\_. 1998. Attini: transition from hunter-gatherer to agriculture. *Behavioral Ecology and Sociology*. 7:143 –156.
- \_\_\_\_\_. 1998. *Consilience: The Unity of Knowledge*. N.Y. Random House. Vintage Books.
- \_\_\_\_\_. 2002. *The Future of Life*. N.Y. Random House. Vintage Books.
- \_\_\_\_\_. 2005. “Intelligent Evolution: The consequences of Charles Darwin’s ‘one long argument.’” *Harvard Magazine*. Nov – December.
- \_\_\_\_\_. Ed. 2006. *From So Simple a Beginning: The Four Great Books of Charles Darwin*. NY: W.W. Norton and Company.
- Winograd, Terry and Fernando Flores. 1987. *Understanding Computers and Cognition: A New Foundation for Design*. Reading, MA: Addison Wesley.
- Woese, Carl. 1967. *The Genetic Code – The Molecular Basis for Genetic Expression*. N.Y.: Harper and Row.
- \_\_\_\_\_. 1979. A proposal concerning the origin of life on the planet Earth: *Journal of Molecular Evolution*. 13:95 – 101.
- \_\_\_\_\_. 1987. “Bacterial Evolution.” *Microbiol. Rev.* 51. 221 – 271.
- \_\_\_\_\_. 2004 “A New Biology for a New Century.” *Microbiology and Molecular Biology Reviews*. June.
- Wolfram, Stephen. 2002. *A New Kind of Science*. Wolfram Media Inc.
- Woody, Andrea and Clark Glymour. 2000. “Autonomy and Anti-reductionism: Missing Elements, What Might Philosophers of Science Discover in Chemistry?” in *Of Minds and Molecules: New Philosophical Perspectives on Chemistry*. Ed. Nalini Bhushan and Stuart Rosenfeld. Oxford University Press.
- Wright, Sewell. 1931. Evolution in Mendelian Populations. *Genetics*. 16. 147.
- Vogel, G. 1998. Did the First Complex Cell Eat Hydrogen? *Science* 279: 1633 – 1634.
- Zinsser, Hans. *As I Remember Him: The Biography of RS*. Boston: Little, Brown and Company. 1940.
- Zubrin, Robert. 1999. *Entering Space*. N.Y.: Jeremy Tarcher/ Putnam.