

15/15/22  
Liberal Arts and Sciences  
Microbiology  
Carl Woese Papers, 1911-2013

### Biographical Note

Carl Woese (1928-2012), who revolutionized the science of microbiology, has been called “the Darwin of the 20<sup>th</sup> century.” Darwin’s theory of evolution dealt with multicellular organisms; Woese brought the single-celled bacteria into the evolutionary fold. The Syracuse-born Woese began his early career as a newly minted Yale Ph.D. studying viruses but he soon joined in the global effort to crack the genetic code. His 1967 book *The Genetic Code: The Molecular Basis for Genetic Expression* became a standard in the field. Woese hoped to discover the evolutionary relationships of microorganisms, and he believed that an RNA molecule located within the ribosome—the cell’s protein factory—offered him a way to get at these connections. A few years after becoming a professor of microbiology at the University of Illinois in 1964, Woese launched an ambitious sequencing program that would ultimately catalog partial ribosomal RNA sequences of hundreds of microorganisms. Woese’s work showed that bacteria evolve, and his perfected RNA “fingerprinting” technique provided the first definitive means of classifying bacteria. In 1976, in the course of this painstaking cataloging effort, Woese came across a ribosomal RNA “fingerprint” from a strange methane-producing organism that did not look like the bacterial sequences he knew so well. As it turned out, Woese had discovered a third form of life—a form of life distinct from the bacteria and from the eukaryotes (organisms, like humans, whose cells have nuclei); he christened these creatures “the archaebacteria” only to later rename them “the archaea” to better differentiate them from the bacteria. In 1980, four years after his discovery of the archaea, Woese unveiled the “Big Tree”—the first tree of life based entirely on ribosomal RNA data. Woese’s tree attempted to trace the evolutionary relationships of the three forms of life going back to their divergence from a common ancestor over three billion years ago. Continuing to probe the origins of life for the rest of his career, Woese would help develop such seminal concepts as the RNA World and the progenote—a hypothetical communal state of life predating the first cell. In 1990 Woese proposed that all life be grouped into three domains: the Archaea, the Bacteria, and the Eucarya. This idea met a great deal of resistance from many of his fellow biologists but is now largely enshrined in the textbooks. Carl Woese died on December 30, 2012, in Urbana, Illinois.

### Timeline

July 15, 1928	Born Syracuse, New York - son of Carl and Gertrude Woese
1942-46	Deerfield Academy, Deerfield, Massachusetts
1950 A.B.	Amherst College, Math and Physics
1953 Ph.D.	Yale University, Biophysics. Thesis: “Physical Studies on Animal Viruses”
1953	Married Gabriella Haws on August 20
1953-55	Medical School, University of Rochester
1955-60	Research Associate, Biophysics, Yale University
1960-63	Biophysicist, General Electric Research Laboratory, Schenectady, New York

	York
1963	Biophysicist, Institute Pasteur
1964-2012	Professor of Microbiology, University of Illinois
1965	“On the Evolution of the Genetic Code” published
1967	<i>The Genetic Code: The Molecular Basis for Genetic Expression</i> published
1970	“Molecular Mechanics of Translation: A Reciprocating Ratchet Mechanism” published
1976	Discovered “third form of life” he christened “archaebacteria”
1977	Discovery announced in <i>Proceedings of the National Academy of Sciences</i> article “Phylogenetic Structure of the Prokaryotic Domain: The Primary Kingdoms”
1980	Tree of life—the “Big Tree”-- based on ribosomal RNA sequences published
1983	Received Bergey Award
1984	Received John D. and Catherine T. MacArthur Award
1987	Landmark paper “Bacterial Evolution” published
1988	Elected to the National Academy of Sciences
1989	Appointed to University of Illinois’ Center for Advanced Study
1990	Proposed division of life into three domains: Archaea, Bacteria, and Eucarya
1992	Awarded the Leeuwenhoek Medal
1996	Selected as first Stanley O. Ikenberry Endowed Chair
1998	“The Universal Ancestor” published
2000	Received National Medal of Science
2003	Awarded the Crafoord Prize in Biosciences
2004	“A New Biology for a New Century” published
2007	Joined Institute for Genomic Biology, University of Illinois
2009	“How the Microbial World Saved Evolution from the Scylla of Molecular Biology and the Charybdis of the Modern Synthesis” published
Dec. 30, 2012	Died, Urbana, Illinois

Box 1:

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- “A Manifesto for Microbial Genomics,” in *Current Biology*.
- “Tetratrico-Peptide-Repeat Proteins in the Archaeon *Methanococcus jannaschii*,” in *Trends in Biochemical Sciences*.
- “*Polaribacter* gen. nov., with Three New Species, *P. irgensii* sp. nov., *P. franzmannii* sp. nov. and *P. filamentus* sp. nov., Gas Vacuolate Polar Marine Bacteria of the *Cytophaga-Flavobacterium-Bacteroides* Group and Reclassification of ‘*Flectobacillus glomeratus*’ as *Polaribacter glomeratus* comb. nov.,” in *International Journal of Systematic Bacteriology*.
- “Default Taxonomy: Ernst Mayr’s View of the Microbial World,” in *Proceedings of the National Academy of Sciences of the United States of America*. Includes annotations by Woese.
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- “Reclassification of *Methanogenium tationis* and *Methanogenium liminatans* as *Methanofollis tationis* gen. nov., comb. nov. and *Methanofollis liminatans* comb. nov. and Description of a New Strain of *Methanofollis liminatans*,” in *International Journal of Systematic Bacteriology*.
- “A New Version of the RDP (Ribosomal Database Project),” in *Nucleic Acids Research*.
- “Archaeal Aminoacyl-tRNA Synthesis: Unique Determinants of a Universal Genetic Code?” in *The Biological Bulletin*.

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- 2000
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- 2005
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- “Evolving Biological Organization,” in *Microbial Phylogeny and Evolution: Concepts and Controversies*, ed. Jan Sapp.
- 2006
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- “How We Do and Don’t and Should Look at Bacteria and Bacteriology,” in *Prokaryotes*.
- 2007
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- “Biology’s Next Revolution,” in *Nature*.
- 2008
- “The Birth of the Archaea: A Personal Retrospective,” in *Archaea: Evolution, Physiology, and Molecular Biology*.

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REPRINTS–NON-WOESE (This file includes reprints of classic microbiology articles, reprints annotated by Woese, and reprints signed by the author.)

1940-50

1951

1952

1953

Box 13:

1954-77

1981-88

1989-94

1995-99

2000-2003

2004-2007

REPRINT REQUESTS (The bulk of these reprint requests are for Woese’s 1965 article “On the Evolution of the Genetic Code” and his 1973 article “Evolution of the Genetic Code.”)

1966 (10 folders)

1966-67

Box 14:

1966-68 (6 folders)

1973

1973-74 (6 folders)

1973-75

1974-75

1975

1989-90

SUBJECT FILE (The subject file includes articles, computer printouts, correspondence, data

sheets, e-mails, exams, illustrations, manuscripts, newspaper clippings, notes, pamphlets, photographs, and slides.)

- 5S Ribosomal RNA Information, 1976-85 (2 folders)
- 5S Ribosomal RNA Sequences, undated
- 16S Ribosomal RNA Oligonucleotide Catalog Data Base, ca. 1981
- 16S Ribosomal RNA Sequences, undated
- 16S Ribosomal RNA Subunit Structure—Includes correspondence with George Fox and Harry Noller, 1976-82 (2 folders)

Box 15:

- 23S Ribosomal RNA, 1988-89
- 23S Ribosomal RNA—Archaea—Includes correspondence with A. Bock, 1984-90
- Aging, undated
- American Academy of Arts and Sciences, 1985
- American Philosophical Society, 2004
- Amherst College—Honorary Doctor of Science, 1984-5
- Amherst College—Prizes, 1948-50
- Amherst College Undergraduate Course Book, 1946-50
- Amherst Magazine*, 2002
- Amino Acid Percentages in Bacteria, 1999
- Appointment Book, 1989
- Archae Families—Ribosomal RNA Sequences, undated
- Archae History—Jan Sapp, 1972-2005
- Archae History Project—Includes correspondence with W. Ford Doolittle, Tom Langworthy and John Oro, 1978, 2004-2005
- “Archae Masters” (Miniature golf outing)—Invitations, 1981-84
- Archae Twentieth Anniversary Party, 1997
- Archaea Evolution Conference, 2007
- Archaea: Molecular Cell Biology—Course Outline, undated Archaea—Photographs, undated
- Articles of Interest, 1977, 1980
- Awards and Honors—Newspaper Articles, 1984-2006
- Bacterioferritin—Paper, undated
- Barbieri, Marcello—“The Ribotype Theory of Evolution,” 1983 (3 folders)
- Big Bacillus and Clostridia, 1979-87
- Beckman Institute—Includes correspondence with William Greenough, 1985-86
- Benjamin Franklin Medal in Life Science—Correspondence, 2006
- Bergey Award—Certificate, 1983
- Biohazard Information, 1979-81
- Bohm, David—Remarks on Order—Includes annotations by Woese, 1980
- Bohr, Niels, “Light and Life” and “Light and Life Revisited,” 1933, 1963
- Brown-Hazen Award Lectures, 1992
- Brosius, Jurgen, 1980-2000



Budget Statements, 1981-82  
 Bulletin Board Items (Found on bulletin board outside Room 371, Morrill Hall, under heading "Space Is the Residue of Becoming")—Includes greeting cards, magazine articles, and newspaper clipping, 1982-2002  
 Burggraf, Siegfried—Dissertation, 1992  
 The Bushido Club—Request for Use of University Premises, 1968  
 Canadian Institute for Advanced Research—Program in Evolutionary Biology, 1986, 1991  
 Carolina Biology Readers—"The Origin of Life" by Carl Woese, 1979-84 (2 folders)  
 Cartoons, undated  
 Champaign County Humane Society—President's Circle Membership Certificate, 1988  
 "Charlie Rose Show" Transcript (Topic: "Charles Darwin," with guests James Watson and E. O. Wilson)—Includes annotations by Woese, 2005  
 Chemical Analyses, 1968-69  
 Chloroflexus and Planctomyces—Includes correspondence with R. C. Fuller, Otto Kandler, Jerome Perry, Erko Stackebrandt, and J. T. Staley, 1981-85

Box 16:

Chromosomes, undated  
 Code Papers, 1971, 1977  
 Codon Reassignment—Paper, undated  
 Computer Data Storage, ca. 1978  
 Condolence Letters, 2013  
 Course Lectures, 1971-73 (2 folders)  
 Crafoord Prize—Correspondence, Press Releases and Photos, 2003 Creationism—Includes correspondence with Thomas Jukes, 1975-86, 2008 (3 folders) Crick, Francis—Talk (on DVD), 2003  
 Darwin, Charles—Includes correspondence with Robert Austin and Terry Hwa, 1911, 2005-2009  
 Darwin, Sir Charles, "How Scientific Discoveries Are Made," undated  
 Darwin, Erasmus, undated  
 Datta, Shoumen, "National Recognition of Excellence for K-12 Standards," 1998  
 Day, William, "How Life Began," 2002  
 Dissertation—Carl Woese ("Physical Studies on Animal Viruses"), 1953  
 Distinguished Lecturer Award, 1980  
 DNA Composition—Articles, 1953-66  
 Doolittle, W. Ford—Papers, 1986, 1999-2000  
 Eddington, Arthur, "The Domain of Physical Science," 1925  
 "Why I Believe in God," 1930  
 Enteric Bacteria—Articles and Notes, 1972  
 Eocyte Controversy—Includes correspondence with Joseph Felsenstein, Roger Garrett, George Harauz, Frank Harold, James Lake, Wen-Hsiung Li., A. T. Matheson, Peter Newmark, Geoffrey North, David Penny, Georg Stoffler, Marina Stoffler-Meilicke, and Wolfram Zillig, 1984-89 (3 folders)

Ephemera (Found taped to cabinets and walls in Room 371, Morrill Hall)—Includes correspondence, postcards, and restaurant menus, 1970s-2004  
 Erasmus Biography  
 Evolution—Articles, 1954-2004 (2 folders)

Box 17:

Fourth Domain, 2011  
 Fractals—Images, undated  
 General Electric *Research Laboratory Bulletin*—Includes article on Woese, 1961  
 Genetic Code, 1969-82 (2 folders)  
 Genetic Code and Translation, 1940-2000  
 Genome/The Institute for Genomic Research (TIGR)—Includes correspondence with Daniel Drell, Lauren Goralski, and Ron Swanson, 1983-98 (2 folders)  
 GenProbe, 1987-88  
 Genta, 1990  
 Gest, Howard—Articles, 2003, 2008  
 Giaever, Ivar—1973 Nobel Lecture in Physics, 1974  
 Gonick, Larry—Cartoon “Science Classics: Archae,” 1990  
 Gould, Stephen Jay—Article (With Woese annotations), 2001  
 Gram Positive Bacteria—Includes correspondence with Richard Devereux, John L. Johnson, Erko Stackebrandt, and Ralph Tanner, 1972-89  
 Grant Proposals, 1985-88  
 Greeting Cards, 2003, 2009  
 Gutell, Robin et. al., “A Compilation of Large-Subunit (23S-Like) Ribosomal RNA Sequences Presented in a Secondary Structure Format,” 1991  
 Halobacterium volcanii Leader Sequence—Includes correspondence with A. Bock and Roger Garrett, 1977-87 (2 folders)  
 Hegel, Georg Wilhelm Friedrich—*Phenomenology of Mind*, undated  
 Holley, Robert, “The Nucleotide Sequence of a Nucleic Acid,” *Scientific American*—Includes annotations by Woese, 1966  
 Honors and Awards, 1979-83  
 Hungate, Robert—Symposium, 1960  
 Stanley O. Ikenberry Endowed Chair—Correspondence and Clipping, 1996  
*Inside Illinois*, 2007  
 Institute for Genomic Biology Fellows Symposium—Program (Woese comments on inside cover), 2012  
 The Institute for Genomic Research (TIGR)—Press Conference Photos, 1996  
 “Introducing French Wines,” 1956  
 Jazz—Note on Charlie Parker, undated  
 Karl August Forster Lecture, 1982  
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 Korarchaeota Contigs—CD, 2006

Laboratory Procedures Manual–Written by Christine Hahn, 1983-84  
 Lactic Acid Bacteria–Includes correspondence with Otto Kandler, Jordan Konisky, R. G. E. Murray, and U. Weber, 1973-91  
 Langworthy, Tom, “Tom’s Recollection of the Archaeobacteria History,” 2004  
 Larsen, Niels, undated  
*LAS Newsletter*, 1983  
 Ledger Statements, 2006-2007  
 Leeuwenhoek Medal–Includes correspondence with W. R. Hugenholtz, Wil N. Konings, A. H. Stouthamer, K. Vrieze, Graham Walker, and I. Willems, 1992, 2003  
 Lwoff, A., “The Concept of a Virus,” 1957  
*MacArthur at 25*–MacArthur Foundation Annual Report, 2002  
 MacArthur Fellows Directory, 1991

Box 18:

Magazine Articles, 1985-2011  
 Manuscripts in Preparation, 1982  
 Mayr, Ernst–Article and Obituary, 1998, 2005  
*mcb: A Magazine*–“Celebrating 30 Years on the Tree of Life,” 2007  
 Memorial Service–Program, 2013  
 Metabolic Inhibitors and Psychedelics–Notebook, undated  
 Methanogens/Meyer Wolin–Includes correspondence with Piero Cammarano, Roger Garrett, T. Gold, Robin Gutell, Masahiro Kamekura, Jorgen Kjems, James McCloskey, Gary Olsen, Meyer Wolin, Wolfram Zillig, and Robert Zimmerman, 1987-90  
 Microbiology 330  
   Exams and Lecture Materials, 1960-70  
   Lecture Notes, ca. 1967-68  
     1969  
     1970 (Includes Woese’s thoughts on state of society)  
   Readings, 1969-70  
   Test Questions, undated  
 Mitochondria–Includes correspondence with M. Edelman, 1977  
 Modified Ribosomal RNA Sequences–Data Sheets, 1979-83 (2 folders)  
 Molecular Evolution Seminar Series–Lecture Notice, undated  
 Multiple Mapping of DNA Fragments, 1990-91  
 Music Class–Notes, Papers, and Song Sheets, 1947  
 National Academy of Sciences–Membership, 1987-2004  
 NASA Exobiology Project, 2005  
 NASA Planetary Biology Meeting–Includes correspondence with Donald DeVincenzi, Hyman Hartman, and Richard Young, 1981  
 NASA Projects–Includes correspondence with Donald DeVincenzi, John Rummel, and Richard Young, 1977-92 (2 folders)

NBC Research Biochemicals–Catalog, 1966  
 National Medal of Science, 2000  
 New RNAs and Sequence Information–Includes correspondence with Charles Beard, Robert Gherna, James Hogan, Roar Irgens, Michael Madigan, Eric Miller, James Petzel, Frank Richards, K. H. Schleifer, Lawrence Shimkets, Erko Stackebrandt, Karl Stetter, Ralph Tanner, Will Whitenflugel, Fritz Widdel, T. Wilharm, Decheng Yang, and Robert Zimmerman, 1988-95 (2 folders)  
 Newspaper Articles, 1959-90  
 Nobel Committees for Physics and Chemistry–Includes correspondence with Astrid Graslund, 1999, 2005  
 Nobel Prize–Nomination, 1996  
 Noller, Harry–Article, 1992 Notebook–re: Methanobacteria, undated Notes, undated  
 Notes on “Darwinism,” 2009

Box 19:

Notes on “Darwinism,” 2009  
 Obituaries, 2013  
 Olsen, Gary–Dissertation, 1983  
 Oparin, A. I., “The Origin of Life,” 1924  
*Oriental Philosophies*, 1985  
 Origin of Life–Includes articles, notes and correspondence with Derek Briggs, Sidney Fox, Thomas Gold, and Gunter Wachtershauser, 1957-95 (3 folders)  
 Pace, Norman, 1961, 1989-2003  
     “Into the Microbial World” Lecture–DVD, 2005  
     National Academy of Sciences Lecture Outline–CD, 2004  
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 Photographs–Includes photos of George Fox, Ramesh Gupta, Robin Gutell, Otto Kandler, Norman Pace, Gary Olsen, David Stahl, Charles Vossierinck, Will Weisburg, Carl Woese, and Ralph Wolfe , 1977-2004 (3 folders)  
 Phylogenetic Analysis Using Parsimony (PAUP) Manual, 1991  
 Procedures for Preparation of ATP and Plasmids, 1979  
 Promega Biotec–Confidential Disclosure Agreement and Correspondence, 1985  
 Pseudomonas-Streptococcus--Ribosomal RNA Sequences, 1974-75  
 Publications List–CDs, 2007-2008  
 Purple Bacteria–Includes correspondence with Frank Richards, 1987-90  
 Qi Gong, 1997  
*Quotations from Chairman Mencken or Poor Henry’s Almanack*, 1974  
 Radioactive Information, 1972-92  
 Radioisotope Laboratory Survey Documentation–Room 371, Morrill Hall, 1981-90  
 Rapid Evolution–Includes correspondence with Joe Felsenstein, W. M. Fitch, Ernst Mayr,

Colin Patterson, and Robin Pellew, 1980-87 (3 folders)  
 Reviewers' Comments–Research Proposal (“Role of Horizontal Gene Transfer as a  
 Control on the Coevolution of Ribosomal Proteins and the Genetic Code,” 2005  
 Reviews, undated

Box 20:

Ribosomal Database Project  
 Correspondence, 1989-93  
 Grant, 1990-93  
 Literature, 1984-96  
 Ribosomal RNA/Ribosomes, 1977-86 (2 folders)  
 Ribosomal RNA Sequences  
 Archaeobacteria, 1986-87 (2 folders)  
 Archaeobacteria and Bacteria, 1984  
 1986-87 (4 folders)  
 Bacteria, undated  
 Gram Positive Eubacteria, 1986-87 (2 folders)  
 Purple Bacteria, 1986-87 (2 folders)  
 Ribosome–Articles, 1980-81  
 RNA Polymerase–Papers, 1987  
 Robb, Frank–Paper, 1993  
 The Royal Society–Correspondence and Newspaper Articles, 2006  
 Sapp, Jan–Papers (Includes Woese annotations), 2005-2007  
 Savant Instruments, Inc.–Blueprints, Correspondence, and Instruction Sheets, 1974-75  
 Seminars–Correspondence, 1979-81

Box 21:

Slides–Includes slides of the “eocyte problem,” phylogenetic trees, and thermophiles,  
 undated (2 folders)  
 Small Ribosomal Subunit RNA Sequences, 1990  
 The Society of the Sigma Xi (Amherst College Chapter)–Membership Certificate, 1950  
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 Sogin, Mitchell L. --Testimony, *Gen-Probe, Inc. v. Microprobe Corp.*, 1995  
 “Some of Our Finest Hours”–University of Illinois Brochure (with Woese annotations),  
 undated  
 Spiegelman, Sol–Obituary, 1983  
 Sol Spiegelman Memorial Fund–Proposal in Support of, undated  
 Stanier, Roger–Includes articles (some annotated by Woese) and correspondence with  
 Albert Balows and Germaine Stanier, 1936-2004 (2 folders)  
 Statement of Plans–Higher Order Structure of Ribosomal RNA, 1983  
 Stetter, Karl and Wolfram Zillig–Photographs, undated  
 “Symmetry and Symmetry Breaking”–Article, 2008

Thank You Cards (from schoolchildren), undated  
 The Three Billion Four Hundred Million, One Hundred and Sixth Archae Okie Open  
 (Miniature golf outing)–Notice, 1985  
 Transcription Elongation Factors–Includes correspondence with Piero Cammarano,  
 Michael Tomm, and Wolfram Zillig, 1991-94  
 Translation–Article, 1968  
 Translation Retrospect–Articles, 1958-2000  
 Transparencies (all undated unless indicated otherwise)  
     16S Ribosomal RNA Structure  
     Aminoacyl tRNA Synthetase Phylogenetic Trees  
     Charles Darwin Quotes  
     Erroneous Concepts in Microbiology  
     The Evolution of a Scientific Career  
     Genetic Code, 2004  
     History of Microbiology  
     History of Microbiology and Phylogenetics  
     Nobel Prize Winners  
     Phylogenetic Trees (2 folders)  
     Phylogenetic Tree and Genetic Signatures  
     Quotations of Noted Biologists, 2001 (2 folders)  
     John Tyndall’s “Belfast Address”  
     J. Craig Venter

Box 22:

Tseng, Tsai-Tien–Lecture, 2002  
 The Universal Tree–Lecture Outline, undated  
 University of Illinois Board of Trustees Distinguished Service Medallion–  
 Correspondence, 2009  
 University of Illinois Judo Club–Certificate of Merit, 1967  
 University Scholars Program, 1986  
 Unpublished Papers  
     “Binding of Transfer RNA by Aminoacyl-tRNA-Synthetase,” 1968  
     “Concerning the Origin of Codon Assignments,” 1969. Includes correspondence  
     with Tracy M. Sonneborn.  
     “Concerning Primary Structure Homology between the 16S and 23S Ribosomal  
     Ribonucleic Acids Isolated from *Escherichia Coli*,” undated  
     “The Effect of Chloramphenicol on Germinating Cultures of *Bacillus Subtilis*  
     Spores,” 1958  
     “Evolution of Translation: Co-Evolutionary Development of Ribosomal Proteins  
     and the Genetic Code,” 2004  
     “The Fractionation of Soluble RNA on Methylated Albumin Columns,” undated  
     “The Genetic Code in Eucaryotes and Procaryotes,” 1969  
     “Interactions of Amino Acid Derivatives with Polynucleotides. I. N-

carboxyanhydrides vs. Polyadenylic and Polyuridylic Acids,” 1964  
 “Is Translation a Pseudosymmetric Process,” ca. 1972  
 “Light and the Origin of Life,” ca. 1963  
 “A Method for Analysis of Operon Structure,” 1967  
 “Molecular Signatures of the Past: Supporting Information,” 2008  
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 “Tempo and Mode in Evolution: Molecular Perspectives,” undated  
 Venter, J. Craig—Photos and Articles, 1996-99  
 Vetsigian, Kalin—Dissertation, 2005  
 Wachtershauser, Gunter—Includes articles and correspondence, 1974-97  
 Selman A. Waksman Award in Microbiology—Nomination, 1992  
 Who’s Who in America, 1970  
 Wimmer, E.—Articles, 1967-68  
 Carl Woese Tribute, American Society of Microbiology—DVDs, 2009  
 Wolfe, Ralph—Includes articles and correspondence, 1982-2006  
 Yellowstone—Photographs, undated  
 Yu, Ming-Tsung, “Mapping of the Ribosomal RNA Cistrons in *Escherichia Coli* K-12,”  
 1969

DISSERTATIONS (produced by Woese students)

1967, Norman Bernard Hecht  
 1967, Masatoshi Kondo  
 1968, Judith Ann Oldham Williams  
 1969, Michael Alan Bleyman  
 1969, Pamela Dee McNamara  
 1969, William Carl Saxinger

Box 23:

1970, Stephen Jules Sogin  
 1972, Mitchell Loyd Sogin  
 1974, Cynthia Ann Cowgill  
 1976, Lawrence Barry Zablen  
 1977, Bobby Joe Lewis

Box 24:

1978, David Allan Stahl  
 1981, Ramesh Gupta  
 1982, JoAnn Lai Wah Kop  
 1986, William Greene Weisburg (2 copies, including one with Woese annotations)

Box 25:

1986, De-Cheng Yang  
 1988, Laurie Achenbach-Richter

#### LABORATORY NOTES

Paper Chromotography Experiments, 1966

NOTES (These notes were written on yellow legal pads.)

“Bacterial Evolution,” ca. 1987  
 Bacteria Signature and Universals, undated  
 Course Lectures, 1994-2004  
 “Darwinism,” 2009-2011  
 Genetic Code, undated  
 “A Phylogenetic Definition of the Gram Negative Bacteria,” undated  
 Phylogenetic Trees, undated

#### Box 26:

#### ARTIFACTS

“Archae Ale”--Bottle  
 Archae Buttons, 1980s  
 Audiotapes  
     “Coleopterissimo”--Beatles Songs  
     “Death of an Archaesalesman”  
     “Round Midnight--the Archae Orchestras”--Jazz Recordings  
 Campbell’s “Primordial” Soup Can  
 Carlsberg Carl’s Special Beer--Bottle, 1997  
 Confucius Family Liquor--Bottle  
 Document Cases (2)  
 Eyeglasses--Two Pairs (One Broken)  
 Framed Photo of Giant Tube Worm--Signed by Norman Pace, Dave Lane, Gary Olsen, and  
     Dave Stahl  
 Gaming Tokens--One Dollar  
     Binion’s Horseshoe  
     Rio, 2002

#### Box 27:

G. H. Mumm & Co. Champagne--Bottle (commemorating Woese’s election to the  
     National Academy of Sciences)--Inscribed, 1988  
 Japanese Headband (Hachimaki)  
 Metal Cube  
 Prokaryote Small Subunit Trees (4), 1994  
 Rotary File  
 Rubber Stamp



Silk Necktie  
 Stamps (5 Envelopes)  
 Tie Clip  
 Tie Pin  
 Wooden Printing Blocks (4)

Box 28:

Awards and Honors--Certificates  
     Crafoord Prize, 2003  
     MacArthur Fellow, 1984  
     Royal Swedish Academy of Sciences Membership, 1997  
     Syracuse University  
         Honorary Doctorate, 1994  
         Citation Accompanying Honorary Doctorate, 1994  
     Selman A. Waksman Award in Microbiology, 1997  
 Bronze Miniatures--Alma Mater  
     Crafoord Prize, 2003  
     Ikenberry Chair, 1996  
 Commemorative Pieces  
     Abbott-ASM Lifetime Achievement Award, 2009  
     Center for Advanced Study Professor, 1989  
     IGB: Conversation with Carl, 2010  
 Glass Globe  
 Illinois License Plate--ARCHAE

Box 29:

Medals  
     Abbott Laboratories Pharmaceutical Products Division Honors, 2009  
     Stanley O. Ikenberry Chair, 1996  
     National Medal of Science, 2000  
     University of Illinois Board of Trustees Distinguished Service Medallion, 2010  
 Neckties  
     The Royal Swedish Academy of Sciences  
     Uppsala University  
 Plaques  
     The Brown-Hazen Award, 1992  
     Storer Lecturer, 1979  
     University Scholar, undated

Box 30: OVERSIZE Box I

Awards and Honors--Certificates

American Academy of Microbiology Fellow, 1994  
 American Society for Microbiology Honorary Member, undated  
 German Academy of Sciences Leopoldina Membership, 1983  
 The German Society for Hygiene and Microbiology–Membership, 1981  
 Illinois House of Representatives Certificate of Recognition, undated  
 National Medal of Science, 2000

Computer Printouts

16S-Like Primers, 1986  
 Database of 16S rRNA Catalogs, undated  
 Eubacterial Complete and Reverse Transcriptase Summary Sequences, 1986  
 Evolutionary Distance Tables, 1981-82  
 Phylogenetic Trees, 1984  
 Ribosomal RNA Oligonucleotide Catalogs, 1981-84  
 Sequence Shuffle Program, 1982

Box 31: OVERSIZE Box II

Illustrations for Articles, Books, and Talks

16S Ribosomal RNA Secondary Structure, undated  
 16S and 18S Ribosomal RNA Secondary Structure, undated  
 23S Ribosomal RNA Secondary Structure, undated  
 Archaea Ribosomal RNA Structure and Phylogenetic Tree, undated  
 “Bacterial Evolution,” 1987  
 Drawings for Tahoe Meeting, undated  
*The Genetic Code: The Molecular Basis for Genetic Expression*, 1967  
 “Higher Order Interactions in 23S rRNA,” undated  
 “Molecular Mechanics of Translation: A Reciprocating Ratchet Mechanism,” 1970  
 Mycoplasma 5S Ribosomal RNA Tree, undated  
 Phylogenetic Trees–Archaeobacteria and Eubacteria, undated  
     Bacteria, undated  
     Methanogens and Purple Bacteria, undated  
 “Phylogeny of Procaryotes,” 1980  
 Two-Dimensional Electrophoretogram, undated  
 Universal Ancestor, undated

Box 32: OVERSIZE Box III

Awards and Honors–Certificates

The Explorers Club Membership, 1978  
 External Scientific Member of the Max Planck Institute for Biochemistry, 1987  
 Newspaper Article re: Honorary Degree from Syracuse University, 1994 Photo–  
 Framed  
 Institute for Genomic Biology Archaea Evolution Conference, 2007  
 Poster

“Whither Microbiology”–Woese Lecture at Uppsala University, 1995

Box 33: OVERSIZE Box IV

Scrapbooks re:

Discovery of Archaea, 1977-81

MacArthur Foundation Grant, 1984

Box 34:

RECORD BOOKS (These green notebooks list 16S ribosomal RNA oligonucleotide sequences of various bacteria and some eukaryotes. All of the notebooks are undated.)

16S RNA Book III

Arthrobacter/Micrococcus

Bacillus group

Bacteroides

Blue-Green Bacteria and Chloroplasts

Clostridium II

Desulfovibrio and Bdellovibrio

Eucaryotes

Gram-Positive Bacteria

Green Bacteria

Lactobacillus/Streptococcus

Mycoplasma

Mycoplasma/Clostridia

Pseudomonas/Rhodospirillum III

Rhodospirillum I

Rhodospirillum II

Rhodospirillum III

Rhodospirillum Group

Spirochete

Oversize in Map Case 3-6, Room 106F, ARC

Diagram Showing 16S Ribosomal RNA Secondary Structure between Positions 230 and 440 for *E. coli*, *V. necatrix*, and *S. cerevisiae*

Illustrations by Stanley Jones for Woese article, “Molecular Mechanics of Translation: A Reciprocating Ratchet Mechanism,” 1970

Posters

“Hidden Before Our Eyes: 30 Years of Molecular Phylogeny,” Institute for Genomic Biology Conference, 2007

Miles Davis

Moe Howard as Mao Zedong

Marshall Nirenberg: Genes and the Future of Man–Includes Woese annotation

## National Medal of Science 2000

Oversize in Room 201, ARC

Framed Drawings of 16S Ribosomal RNA Structure (4)

Oversize in Room 121, ARC

Electrophoresis Chamber

## X-RAY FILMS

Beginning about 1970, Carl Woese and his students began to partially sequence the ribosomal RNA of numerous microorganisms with the ultimate hope of shedding light on the early evolutionary development of the cell. “Therefore, what I want to do is to determine primary structures for a number of genes in a very diverse group of organisms, on the hope that by deducing rather ancient ancestor sequences for these genes, one will eventually be in the position of being able to see features of the cell’s evolution,” Woese explained in a 1969 letter to Francis Crick, co-discoverer of the DNA double helix. Woese employed an expensive, complex and time-consuming process known as polyacrylamide gel electrophoresis to separate the RNA fragments. The end result of this process was a so-called Sanger pattern on an X-ray film showing the organism’s partial ribosomal RNA sequences. These sequences appeared on the film as hazy spots or “blobs”; the “blobs” were the “fingerprints” that allowed Woese and his students to identify the organism. In 1976 Woese noticed that the Sanger pattern of an organism called *Methanobacterium thermoautotrophicum* (nicknamed “delta H” for short) didn’t have the tell-tale spots of a bacterial species, and this observation led to Woese’s discovery of the Archaea—the third form of life. Documenting some twenty years of Woese’s work on the cutting edge of microbiology research, the X-ray films contain Sanger patterns of the ribosomal RNA of hundreds of microorganisms and are organized alphabetically by organism.

Note: “S” stands for Svedberg unit—a measure of the rate at which a molecule turns to sediment in an ultracentrifuge; 16S refers to the ribosomal RNA of the smaller of the two subunits that make up the ribosome; 23S and 5S are the ribosomal RNA of the larger of the two subunits.

Box 35:*Acetobacterium woodii* 16S, 1976-77Box 36:*Acetogen* 16S, 1980

Box 37:

*Acholeplasma laidlawii* 16S, 1975-76

Box 38:

*Acholeplasma laidlawii* 16S, 1975-76

Box 39:

*Acholeplasma laidlawii* 16S, 1975-76

Box 40:

*Acholeplasma laidlawii* 16S, 1975-76

Box 41:

*Acinetobacter* 16S, 1974

Box 42:

*Acinetobacter* 16S, 1974

Box 43:

*Acinetobacter calcoaceticus* 16S, 1974

Box 44:

*Acinetobacter calcoaceticus* 16S, 1979

Box 45:

*Actinomyces bovis* 16S/*Actinomyces viscosus* 16S, 1978

Box 46:

*Aerobacter*, 1971

Box 47:

*Aerobacter* 5S, undated

Box 48:

*Aerobacter aerogenes* 16S, 1972

Box 49:

*Aerobacter aerogenes* 16S, 1972

Box 50:

*Aerobacter aerogenes* 16S, 1972

Box 51:

*Aeromonas liquifaciens* 5S, 1973

Box 52:

*Aeromonas liquifaciens* 16S, 1973

Box 53:

*Agrobacterium tumefaciens* 23S, 1984-85

Box 54:

*Agrobacterium tumefaciens* 23S, 1984-85

Box 55:

*Alcaligenes aestus* 5S, 1976

Box 56:

*Alcaligenes aestus* 16S, 1976

Box 57:

*Alcaligenes eutrophus* 16S /*Pseudomonas diminuta* 16S, 1980

Box 58:

*Alcaligenes faecalis* 16S, 1974

Box 59:

*Alcaligenes faecalis* 16S, 1974

Box 60:

*Alcaligenes faecalis* 16S, 1974

Box 61:

*Alcaligenes faecalis* 16S, 1974

Box 62:

*Alcaligenes faecalis* 16S, 1983

Box 63:

Amino Acid Experiments, undated

Box 64:

*Anacystis nidulans* 16S, 1972

Box 65:

*Aphanocapsa* 4S and 16S, 1976

Box 66:

*Aquaspirillum aquaticum* 16S/*Aquaspirillum dispar* 16S, 1981-82

Box 67:

*Aquaspirillum bengal* 16S, 1982

Box 68:

*Aquaspirillum gracile* 16S/*Aquaspirillum serpens* 16S, 1979-80

Box 69:

*Aquaspirillum itersonii* 16S/*Rhodospirillum rubrum* 16S, 1976-78

Box 70:

*Archaeoglobus* 7S, undated

Box 71:

*Archaeoglobus fulgidis* 5S, undated

Box 72:

Archaeoviruses-Photographs, 1982

Box 73:

*Arthrobacter atrocyaneus* 16S/*Arthrobacter variabilis* 16S, 1978

Box 74:

*Arthrobacter globiformis*, undated

Box 75:

*Arthrobacter globiformis* 16S/*Arthrobacter oxydans* 16S/*Arthrobacter simplex* 16S, 1978

Box 76:

*Azotobacter vinelandii*, 1978

Box 77:

*Bacillus acidocaldarius* 5S/*Methanobacterium* M-1 5S/*Acholeplasma* 5S, 1976

Box 78:

*Bacillus acidocaldarius* 16S, 1976

Box 79:

*Bacillus alvei* 16S, 1976

Box 80:

*Bacillus badius* 16s/*Bacillus coagulans* 16S, 1976



Box 81:

*Bacillus brevis* 5S, 1974

Box 82:

*Bacillus brevis* 16S, 1974

Box 83:

*Bacillus brevis* 16S/*Escherichia coli* 16S, 1974-75

Box 84:

*Bacillus brevis* 16S, 1976

Box 85:

*Bacillus brevis* 16S, 1976

Box 86:

*Bacillus brevis* 16S, 1977

Box 87:

*Bacillus brevis* 16S, 1978

Box 88:

*Bacillus brevis* 16S, 1978

Box 89:

*Bacillus brevis* 16S, 1978-79

Box 90:

*Bacillus brevis* 16S, 1979

Box 91:

*Bacillus brevis* 16S, 1979

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Box 92:

*Bacillus brevis* 16S, 1979

Box 93:

*Bacillus brevis* 16S, 1979

Box 94:

*Bacillus brevis* 16S, 1979

Box 95:

*Bacillus brevis* 16S, 1979

Box 96:

*Bacillus brevis* 16S, 1979

Box 97:

*Bacillus brevis* 16S, 1979

Box 98:

*Bacillus brevis* 16S, 1979

Box 99:

*Bacillus brevis* 16S, 1979

Box 100:

*Bacillus brevis* 16S, 1979

Box 101:

*Bacillus brevis* 16S, 1979

Box 102:

*Bacillus brevis* 16S, 1979

Box 103:

*Bacillus brevis* 23S, 1974

Box 104:

*Bacillus brevis* 23S, 1974

Box 105:

*Bacillus brevis* 30S, 1974

Box 106:

*Bacillus brevis* 30S, 1976

Box 107:

*Bacillus brevis* 953 16S/*Bacillus brevis* 1028 16S, 1976

Box 108:

*Bacillus brevis* 1028 5S/*Bacillus brevis* 12991 5S/*Bacillus polymyxa* 5S, 1976

Box 109:

*Bacillus brevis* 8185 5S, 1976

Box 110:

*Bacillus brevis* 8185 5S, 1976-77

Box 111:

*Bacillus brevis* 8185 5S, 1977

Box 112:

*Bacillus brevis* 8185 5S, 1977

Box 113:

*Bacillus brevis* 8185 5S, 1977

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Box 114:

*Bacillus brevis* 8185 5S, 1977

Box 115:

*Bacillus brevis* 8185 5S, 1977

Box 116:

*Bacillus brevis* 8185 16S, 1973-74, 1976

Box 117:

*Bacillus brevis* 8185 23S, 1977

Box 118:

*Bacillus brevis* 8185 50S, 1976

Box 119:

*Bacillus brevis* 8185 50S, 1976

Box 120:

*Bacillus brevis* 12991 16S, 1976

Box 121:

*Bacillus cereus* 5S, 1974

Box 122:

*Bacillus cereus* 16S, 1974

Box 123:

*Bacillus cereus* 16S, 1974

Box 124:

*Bacillus fastidiosus* 16S, 1977

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Box 125:

*Bacillus firmus* 5S, 1976

Box 126:

*Bacillus firmus* 16S, 1976

Box 127:

*Bacillus insolitus* 16S, 1976

Box 128:

*Bacillus megaterium* 5S, 1971

Box 129:

*Bacillus megaterium* 5S, 1974

Box 130:

*Bacillus megaterium* 5S, 1974

Box 131:

*Bacillus megaterium* 5S/*Bacillus subtilis* 5S, 1974

Box 132:

*Bacillus megaterium* 16S, 1972

Box 133:

*Bacillus megaterium*/*Escherichia coli* 16S, 1973

Box 134:

*Bacillus megaterium* 16S, undated

Box 135:

*Bacillus megaterium* 23S, 1974

Box 136:

*Bacillus pasteurii* 5S/*Sporosarcina ureae* 5S, 1974

Box 137:

*Bacillus pasteurii* 16S, 1973

Box 138:

*Bacillus pasteurii* 16S, 1974

Box 139:

*Bacillus polymyxa* 16S, 1976

Box 140:

*Bacillus pumilus* 16S, 1974

Box 141:

*Bacillus pumilus* 16S, 1974

Box 142:

*Bacillus psychrophilus* 16S, 1976

Box 143:

*Bacillus sphaericus* 5S/*Aphanocapsa* 6714 5S/*Rhodomicrobium* 5S, 1976

Box 144:

*Bacillus sphaericus* 16S, 1976

Box 145:

*Bacillus stearothermophilus* 16S, 1973

Box 146:

*Bacillus stearothermophilus* 16S, 1973

Box 147:

*Bacillus stearothermophilus* 16S, 1981

Box 148:

*Bacillus stearothermophilus* 23S, 1981

Box 149:

*Bacillus subtilis* 16S, 1975

Box 150:

*Bacillus subtilis* 16S, 1975

Box 151:

*Bacillus subtilis* 16S, 1975

Box 152:

*Bacillus subtilis* 16S, 1979

Box 153:

*Bacteroides amylophilus* 16S, 1981-82

Box 154:

*Bacteroides asaccharolyticus* 16S, 1983

Box 155:

*Bacteroides asaccharovorum* 16S, 1983

Box 156:

*Bacteroides* "Bruce contaminant," 1982

Box 157:

*Bacteroides distasonis* 16S/*Bacteroides vulgatus* 16S, 1982

Box 158:

*Bacteroides fragilis* 16S/*Bacteroides thetaiotaomicron* 16S, 1982

Box 159:

*Bacteroides gingivalis* 16S, 1983

Box 160:

*Bacteroides melaninogenicus* 16S/*Bacteroides ovatus* 16S, 1982

Box 161:

*Bacteroides ruminicola* 16S, 1983

Box 162:

"*Bacteroides*" *succinogenes* 16S, 1981-82

Box 163:

*Bacteroides uniformis* 16S/*Bacteroides ruminicola* 5S, 1982

Box 164:

*Bacteroides vulgatus* 5S/16S, 1983 (2 folders)

Box 165:

*Bacteroides vulgatus* 5S/*Sulfolobus solfataricus* 5S, 1983

Box 166:

*Bacteroides vulgatus* 5S/*Thermoplasma* 5S/*Sulfolobus solfataricus* 5S, 1983

Box 167:

*Bdellovibrio* 16S, 1977

Box 168:

*Bdellovibrio stolpii* 16S/*Bdellovibrio* BM4 16S, 1980, 1983



Box 169:

*Beggiatoa leptomitiformis* 16S, 1982

Box 170:

*Bifidobacterium/Propionibacterium/Micrococcus/Arthrobacter sp.*, 1988

Box 171:

*Bifidobacterium bifidum* 16S/*Bifidobacterium breve* 16S, 1978

Box 172:

*Blastocladia*, 1977

Box 173:

*Brevibacterium linens* 16S/*Brevibacterium ketoglutamicum* 16S, 1978

Box 174:

*Butyrivibrio fibrosolvens* 16S, 1982

Box 175:

*Caulobacter crescentus*, 1985

Box 176:

*Cellulomonas flavigena* 16S/*Cellulomonas cartalyticum* 16S, 1978

Box 177:

Chloroacetaldehyde Experiments, 1974

Box 178:

*Chlorobium pharovibrio forme* 16S, 1982

Box 179:

*Chlorobium limicola* 16S, 1982

Box 180:

*Chlorobium vibrioforma* 16S/*Chloroherpeton* 16S, 1976, 1982

Box 181:

*Chloroflexus* 16S, 1976-77

Box 182:

*Chloroflexus aurantiacus*, 1985

Box 183:

Chloroplast 16S, 1974

Box 184:

*Chromatium* 5S, 1976

Box 185:

*Chromatium* 16S, 1976

Box 186:

*Chromatium tepidum* 16S, 1985

Box 187:

*Chromobacterium violaceum* 16S/*Chromobacterium lividum* 16S, 1979-80

Box 188:

*Clostridium acetivum* 16S/*Clostridium formicoaceticum* 16S, 1980

Box 189:

*Clostridium acidurici* 16S, 1977

Box 190:

*Clostridium aminovalericum* 5S/*Clostridium cochlearum*/*Clostridium innocuum* 5S, 1978

Box 191:

*Clostridium aminovalericum* 16S/*Clostridium oroticum* 16S, 1977-78

Box 192:

*Clostridium barkeri* 16S, 1977

Box 193:

*Clostridium barkeri* 16S, 1986

Box 194:

*Clostridium barkeri*/*Sporomusa*/*Methanococcus*, 1986

Box 195:

*Clostridium butyricum* 16S/*Clostridium scatologenes* 16S, 1978

Box 196:

*Clostridium cylindrosporum* 16S, 1981-82

Box 197:

*Clostridium indolis* 16S/*Clostridium sphenoides* 16S, 1978

Box 198:

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Box 578:

*Vibrio marinus* 16S, 1974

Box 579:

*Wolinella succinogenes*, 1985

Box 580:

*Xanthomonas campestris* 16S, 1980

Box 581:

Yeast 18S, 1972

Box 582:

Yeast 18S, 1972

Box 583:

Yeast 18S, 1972

Box 584:

Yeast 18S, 1974

Box 585:

Yeast 18S, 1977

Box 586:

*Yersinia pestis*, 1973

Box 587:

*Yersinia pestis*, 1973

Box 588:

*Yersinia pestis /Serratia marcescens/Photobacterium fischeri "MAV"/Photobacterium 8265/Pasteurella multocida/Rhodopseudomonas-Salt Patterns*, 1974

Box 589:

Lab Correspondence, 1985-1992 (2 folders)

Lab Notes

Experiments: Bettina, 1984

Heliobacterium, 1984

Pseudomonas Teststeronii AJ 2230, 1984

RNA Sequencing W/RT/Sulfolobus 235 Sequencing, 1985 (2 folders)

SMENT Sulfolobus, 1985-1986 (2 folders)

Microsporidia, 1986 (2 folders)

RNA Sequences, 1986

1986-1988 (2 folders)

A. Ching Notes: T. Celer; M. Hungatei Erase – A – Base etc., 1987-1989

Mapping, 1989-1990 (2 folders)

Flavobacterium Heparinum, circa 1980

Linda (Paul) Mandelco Notes

Binder 1, 1985-1986

Binder 2, 1986-1987

Binder 3, 1988-1989 (2 folders)

Binder 4, 1991-1992

Binder 5, 1992-1993 (2 folders)

Binder 6, 1984, 1993-1994 (2 folders)