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Case Study: Asilomar Conference on Laboratory Precautions When Conducting Recombinant DNA Research

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Appendix D: Biographical Notes on Scientists involved in the Asilomar Process

M.J. Peterson
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Edward A. Adelberg (1920-2009). PhD Yale 1949. Chair of Yale Department of Microbiology 1961-64 and 1970-72; a founding member of Yale Department of Genetics. Deputy Provost for the Biomedical Sciences, 1983-91. Specialist in plasmid biochemistry of *E. coli*.

Ephraim Anderson (1911-2006). M.D., Durham University. Served in the Royal Army Medical Corps during World War II where he developed interests in Epidemiology. Researcher in Enteric Laboratory of the British Public Health Laboratory Service 1947, Deputy Director 1952, Director 1954-1978. Came to public notice for tracing sources of typhoid outbreaks in Zermatt (1963) and Aberdeen (1964). Built on earlier work by Japanese researchers to demonstrate the plasmid-based pathways by which bacteria could spread antibiotic resistance to others and became the world's leading expert on antibiotic resistance. Also prominent in efforts to limit use of antibiotics in raising animals. Fellow of the Royal Society 1968; Companion of the Order of the British Empire 1976.

Eric Ashby, Baron Ashby (1904-1992). Lecturer in Botany, Imperial College London 1931-35; Reader in Botany Bristol University 1935-37; Professor of Botany University of Sydney 1938-1946; Chair of Botany, University of Manchester 1947-50. Turned to administration as President and Vice-Chancellor of Queen's University, Belfast 1950-59; Master of Clare College in Cambridge University 1959-67 and Vice-Chancellor of Cambridge University 1967-1969. Chancellor, Queen's University, Belfast 1970-1983. Chair of the Royal Commission on Environmental Pollution 1970-73. Fellow of the Royal Society 1963. Knighted 1956; created life peer 1973.

W. Emmett Barkley. PhD Environmental Health, University of Minnesota 1972. US Public Health Service commissioned corps 1961-1989. Director of Office of Research Safety, National Cancer Institute 1974-1979; Director of Division of Safety, NIH Office of Research Services 1979-1987; Director of Division of Engineering Services, NIH Office of Research Services, 1987-1989; Director of Laboratory Safety, Howard Hughes Medical Institute 1989-2006.

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David Baltimore (1938-). Microbiologist specializing in RNA viruses. PhD Rockefeller Institute (now Rockefeller University) 1964; Post-doctoral Fellow, MIT. Co-discovered reverse transcriptase enzymes allowing RNA to replicate itself. Professor, MIT 1972. Lifetime Research Professor of the American Cancer Society 1973. Elected to the National Academy of Sciences, 1974. Nobel Prize, 1975.

Jonathan Beckwith (1938-). PhD in Biochemical Sciences, Harvard 1961. National Institutes of Health Post-doctoral Fellow in the laboratories of Arthur Pardee (Berkeley and Princeton), William Hayes (London), Sidney Brenner (Cambridge), and Francois Jacob (Paris). Professor of Bacteriology and Immunology, Harvard, 1969. Expert in protein expression, secretion, membrane dynamics and division in the bacterium *Escherichia coli*. In 1969 he was the first scientist to isolate a particular gene. Active in Science for the People and in public comment on social implications of rDNA technologies. Eli Lilly Award for Outstanding Achievement in Microbiology 1970; Genetics Society of America Medal 1993; US National Academy of Science Selman A. Waksman Award in Microbiology 2009.

Paul Berg (1926-). US Navy 1943-46. PhD Case Western Reserve University 1952, followed by post-doctoral positions. Assistant Professor of Microbiology Washington University, St. Louis 1956. Appointed Professor of Biochemistry at Stanford University School of Medicine when Stanford recruited Arthur Kornberg (Nobel Prize, 1959) to start up a biochemistry department; Chairman Biochemistry Department 1969–1974. By 1965 he was well known for his part in Kornberg's work on how *E. coli* synthesizes proteins and for his own work on chemical models for producing proteins and RNA in test tubes. American Chemical Society's Eli Lilly Prize in biochemistry 1959; V.D. Mattia Award of the Roche Institute of Molecular Biology 1972; Nobel Prize 1980

Herbert Boyer (1936-). Ph.D. in Bacteriology, University of Pittsburgh, 1963. Post-doctoral Fellow at Yale, studying enzymology and protein chemistry 1963-66. Assistant professor at the University of California at San Francisco 1966. Professor 1976. Specialist in restriction enzymes who isolated EcoR1 enzyme. In collaboration with Stanley Cohen, artificially constructed, new and functional deoxyribonucleic acid (DNA) from two separate gene sources. Later collaborated with Stanley Cohen and John Morrow in experiments using plasmids to transfer DNA from the African frog species *Xenopus* to *E. coli*. Participated in startup of Genentech, 1976 and became its Vice President for research while also holding his university position. Resigned from Genentech 1990. V. D. Mattia Award of the Roche Institute of Molecular Biology 1977, Albert and Mary Lasker Medical Research Award 1980.

Sydney Brenner (1927-). D.Phil, Exeter College of Oxford University. Researcher in Francis Crick's Laboratory of Molecular Biology at Cambridge University. Senior researcher on molecular genetics, Medical Research Council Laboratory, Cambridge, England. Contributed to central advances in understanding the workings of DNA and RNA in the 1960s. Fellow of the Royal Society; Nobel Prize 2002.

Donald Brown. Carnegie Institute, Baltimore. Specialist in molecular embryology, known for expertise in gene expression and control. Early user of restriction enzymes to create rDNA.

Ernest Chu. Born in China, PhD Berkeley 1954. Faculty, Yale University and Researcher at Oak Ridge National Laboratory. Professor of Human Genetics, University of Michigan 1972-. In the late 1950s used cytogenetic techniques to identify mutations in chromosomes; later shifted to study of effects of X-ray and ultraviolet radiation on genes, then to effects of exposure to chemicals on genes.

Stanley N. Cohen (1935-). PhD, University of Pennsylvania 1960. Short research appointments ending with a post-doctoral fellowship at the Albert Einstein College of Medicine in New York in 1966-67. Assistant Professor of Medicine at Stanford University 1968, Professor of Medicine 1975, and Professor of Genetics 1977. Expanded Joshua Lederberg's work on plasmids to include using them to carry genetic material into E coli bacteria. Collaborated with Herbert Boyer and John Morrow in experiments transferring DNA from the African frog species *Xenopus* to E. coli with plasmids.

Roy Curtiss III (1934-). Professor of Microbiology, University of Alabama Medical Center. Expert on E. coli and leading specialist on methods for modifying E. coli so it could not reproduce or survive outside of a lab.

Ronald (Ron) Davis. Assistant Professor of Biochemistry, Stanford University Medical School 1972. Professor of Biochemistry and of Genetics, Director of the Stanford Genome Technology Center. Co-discovered fact Eco1R enzyme cuts DNA in a way that permits DNA fragments to reassemble. Elected to the National Academy of Sciences, 1983.

Peter Day. PhD. in Botany. Connecticut Agricultural Experimental Station. Expert in plant pathogens.

Stanley Falkow (1934-). Professor of Microbiology, University of Washington School of Medicine 1975. Professor of Microbiology and Immunology, Stanford Medical School 1981. Expert in E. coli, plasmids, and mechanisms by which some bacteria but not others cause disease in hosts.

Donald S. Fredrickson (1924-2002). M.D. University of Michigan 1949. Researcher, National Heart Institute 1953- 61; Head of Section on Molecular Disease 1961-66; Head of Molecular Disease Branch 1966-74 and Director of the NHI 1966-68. Director of the National Academy of Sciences Institute of Medicine 1974-5; Director of the National Institutes of Health 1975-81; President of Howard Hughes Medical Institute 1984-87. Specialist on lipids. Led development of a classification for lipid diseases, which as the Fredrickson Classification of the Hyperlipidemias was adopted internationally by the World Health Organization in 1972. Fredrickson, John Stanbury and James Wyngaarden created and edited 5 editions of *The Metabolic Basis of Inherited Disease* between 1960 and 1983.

David S. Hogness (1925-). PhD, California Institute of Technology 1952. Assistant Professor of Microbiology, Washington University in St. Louis 1955. Professor, moved to Stanford University in 1959 when Arthur Kornberg was recruited by Stanford University to create a new Department of Biochemistry. Chair of Biochemistry Department 1986-89; Professor of Developmental Biology and Biochemistry 1989-. Helped form the field of rDNA research by his techniques for mapping chromosomes and isolating mutant genes by locating their position within the chromosome. Elected to the National Academy of Sciences, 1976.

David Jackson. Graduate student at Stanford University. Collaborator with Paul Berg on projects seeking to join DNA outside of cells.

Niels K. Jerne (1911-1994). M.D. University of Copenhagen 1951; Researcher in Immunology at the Danish State Serum Institute 1946-53. Research Fellow at the California Institute of Technology at Pasadena, 1955. Chief Medical Officer with the World Health Organization in Geneva, Switzerland, 1956-60. University of Geneva Biophysics Department 1960-62. Professor of Microbiology at the University of

Pittsburgh in Pennsylvania, 1962-66. Director, Basel Institute for Immunology 1969-1980. Head of the European Molecular Biology Organization in mid 1970s. Developed three theories showing how antibodies are produced, formed, and regulated by the immune system that went against prevailing beliefs when first published. Developed the Jerne Plaque Assay Method of counting anti-body producing cells.

Jonathan King. PhD, California Institute of Technology 1968. Assistant Professor of Molecular Biology, MIT, 1970; Professor 1979-. In 1970s worked on mechanisms of icosahedral shell assembly and DNA packaging. Collaborated in discovery of scaffolding proteins that contribute to assembly of virus shells but disappear after assembly is complete. Then studied mutants that prevent virus assembly before taking up current interest in how the amino acid sequence of proteins and mutations in that sequence determines their folding into correct or incorrect structure. Active in discussions of the social implications of genetic research through memberships in the American Association for the Advancement of Science and the Council on Responsible Genetics.

Elizabeth Kutter. PhD in Biophysics, University of Rochester 1968. Member of the Faculty, Evergreen State College (Olympia Washington) 1972; Founder and Head of Evergreen Bacteriophage Laboratory, 1975. Research focuses on phages and their potential as cures for bacterial infections.

Joshua Lederberg (1925-2008). PhD Yale 1948. Faculty appointment at the University of Wisconsin 1948-58; Recruited to chair the new genetics department at Stanford University in 1958. President of Rockefeller University 1978- 1990. Experiments with Edward Lawrie Tatum in 1946 showed that bacteria may reproduce sexually, also demonstrating that bacteria possess genetic systems comparable to those of higher organisms, thus providing a new repertoire for scientists to study the genetic basis of life. Later work included discovering genetic conjugation (transfer of whole chromosome complements) and transduction (transfer chromosome fragments) from cell to cell via plasmids. The work on conjugation and transduction was the first manipulation of genetic material. In the 1950s he perfected a method for isolating mutant bacteria species using ultraviolet light. Also interbred two strains of bacteria--one resistant to penicillin and the other to streptomycin--and produce a bacteria resistant to both antibiotics and developed techniques for manipulating a virus's virulence. Nobel Prize 1958.

Andrew M. Lewis. National Institute of Allergy and Infectious Diseases. Virus specialist who had hybridized monkey virus SV-40 with human adenoviruses. Presenter at Asilomar Conference on lack of full compliance with Memoranda of Understanding and Agreement on distribution of his hybrids.

Peter Lobban. Graduate student at Stanford in 1972. First to propose a more direct method for recombining DNA and helped work it out in the lab.

Janet Mertz. Graduate student in Paul Berg's lab at Stanford University 1970-75. PhD Stanford 1975. Professor of Oncology, McArdle Laboratory for Cancer Research, University of Wisconsin School of Medicine and Public Health. Co-discovered fact Eco1R enzyme cuts DNA in a way that permits DNA fragments to reassemble. Later research focused on mechanisms of gene expression in tumor viruses.

John Morrow. Researcher at Stanford Medical School. Senior collaborator with Herbert Boyer and Stanley Cohen in experiments transferring DNA from the African frog species *Xenopus* to *E. coli* with plasmids.

Daniel Nathans (1928-1999). M.D., Washington University St Louis 1954. Clinical Associate, National Cancer Institute 1955-57; United States Public Health Service Grant to do biochemical research at Rockefeller University in New York, 1959. Faculty positions at Johns Hopkins University, 1962-67. Professor of Molecular Biology 1967; Director of the Molecular Biology and Genetics Department, 1972 and Boury Professor of Molecular Biology and Genetics in 1976. Building on work by Werner Arber (Basel University), who developed Type I restriction enzymes that could cleave DNA, but only in random patterns and Hamilton O. Smith (Johns Hopkins University) who developed Type II restriction enzymes able to cut DNA molecules into specific and predictable fragments. Nathans used Smith's enzyme to cut SV40 DNA into eleven pieces and show its method of replication. He also used radioactive labeling of genetic fragments. Shared Nobel Prize with Arber and Smith, 1978.

Richard Novick. Public Health Research Institute, New York. Microbiologist known for expertise in plasmids, particularly the R plasmids that give cells resistance to antibiotics.

Richard O. Roblin III. Assistant Professor of Microbiology, Harvard Medical School, 197-. Member of the Council for Biology in Human Affairs.

Wallace P. Rowe (1926-1983). M.D., Postdoctoral Researcher at National Institute of Allergy and Infectious Diseases 1953; Researcher and Head of Virology Lab. First to isolate adenoviruses and begin understanding their characteristics. National Academy of Sciences Selman A. Waksman Award in Microbiology 1976.

Jane Setlow (1920-2010). PhD in Biophysics, Yale University 1959. Biologist and Senior Geneticist in the Biology Division of Oak Ridge National Laboratory 1960; Senior Geneticist with tenure 1974-1993. Work focused on DNA damage, DNA repair, and DNA recombination in bacteria and yeast. One of the first researchers to investigate the effects of radiation on the highly resistant bacterium *Micrococcus radiodurans* in the mid 1960s. Founding editor of the series *Genetic Engineering: Principles & Methods* in 1979. President of the Biophysical Society, 1977.

Maxine Singer (1931-). PhD Yale, 1957. Research Biochemist at National Institute of Arthritis and Metabolic Diseases (later National Institute of Arthritis, Metabolism, and Digestive Diseases) 1958-75; Chief of Nucleic Acid Enzymology Section, National Cancer Institute (NCI) 1975-80; Chief of the Laboratory of Biochemistry in 1980-88. President of the Carnegie Institution of Washington 1988-2002. Pursued research in the areas of RNA synthesis, the role of enzymes in DNA and RNA synthesis, and genetic recombination in defective viruses. Elected to the National Academy of Sciences, 1979.

Robert Sinsheimer. Professor and Head of the Biology Department, California Institute of Technology (CalTech). Critic of rDNA research and genetic engineering.

Daniel Singer. Lawyer husband of Maxine Singer, interested in scientific ethics. Vice President of the Institute of Society, Ethics, and Life Sciences in New York.

DeWitt Stettin. M.D., Columbia University 193-. Internship at Bellevue Hospital, New York. PhD in Biochemistry, Columbia University 1940. NIH, 1954-1962. Dean of – Medical School 1962-1970. Director of the National Institute of General Medical Sciences, 1970-. Deputy Director for Science, NIH 197-. Chair of the NIH Recombinant DNA Advisory Committee 1975-.

Bob Symons. Collaborator with Berg at Stanford on projects seeking to join DNA outside of cells.

Waclaw Szybalski (1921-). PhD Gdansk Technical University 1949. Improvised career 1944-49; Visiting Researcher in Copenhagen when dismissed from post. Emigrated to USA 1950. Researcher, Cold Spring Harbor Laboratories 1950-55; Institute of Microbiology, Rutgers University 1955-60; Associate Professor of Oncology, University of Wisconsin-Madison 1960-63; Professor 1963-2003. Specialist in bacteriophages. Developed paper chromatography and gradient plate technique to measure antibiotic resistance of bacteria; an early formulator of multi-drug antibiotic therapies, considerable work on gene mutations and restriction enzymes.

Charles Thomas. Professor of Biological Chemistry, Harvard Medical School. NIH rDNA Advisory Committee,

James Watson (1928-). PhD Indiana University 1950. Post-doctoral researcher at Statens Serum Institut (Copenhagen) and at Cambridge University 1951-53; faculty positions in Harvard University Department of Biology 1956-76. Director of the Cold Spring Harbor Laboratory 1968-1994; President 1994-2004. Head of the Human Genome Project, National Institutes of Health 1990-92. Co-author of paper suggesting double helix structure of DNA molecules. Nobel Prize 1962.

Sherman Weissman. M.D., Harvard 1955. Clinical Associate, National Institutes of Health 1956-58; Senior Investigator, National Cancer Institute 1960-67; Associate Professor Yale University 1967; Professor 1972-.

Norton Zinder (1928-). PhD, University of Wisconsin-Madison 1952. Professor, Rockefeller University, New York City 1964-99. As a graduate student under Joshua Lederberg helped discover that bacteriophages can carry genetic material from one bacterium to another and they named the process transduction. Discovered the first bacteriophage having RNA in 1961. Elected to the National Academy of Sciences, 1969.

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