1.H.S. Anker, “A Possible Biochemical Mechanism for Memory,” (Reprinted from *Nature,* vol. 188, p. 938, Dec. 10, 1960). The molecular theory of memory was further developed by Leo Szilard in his last published paper, “On Memory and Recall,” *Proc. Natl. Acad. Sci.*, 51:1092-1099 (1964)

2.J. Claude Bennett and William J. Dreyer, “Genetic Coding for Protein Structure,” (Reprinted from *Annual Review of Biochemistry*, vol. 33, 1964, pp. 205-234.) Dreyer invented new techniques for protein sequencing and later developed the first automatic protein sequencer.

3.Seymour Benzer, “Fine Structure of a Genetic Region in Bacteriophage,” (Reprinted from the *Proceedings of the National Academy of Sciences,* 41:6, pp. 344-354, June 1955.) The first description of the *r*II system. Benzer provided the evidence that a gene consists of distinct sub-units. His research led to a system of fine genetic mapping that revolutionized the field of genetics. “My discovery at Purdue was a gene and a phage and a set of bacterial strains which had the right kind of properties so that one could in a sense split the gene into its internal parts and construct a map of them in just the same way as was already done for sequences of genes on a chromosome,” Benzer, quoted in Horace Freeland Judson, *The Eighth Day of Creation,* Simon and Schuster (1979), pp. 273-276. “Mapping the *r*II region...was an example of what we called ‘Hershey Heaven.’ This expression comes from a reply that Alfred Hershey gave when [Alan] Garen once asked him for his idea of scientific happiness: ‘To have one experiment that works, and keep doing it all the time,’” Benzer, ”Adventures in the *r*II Region,” in *Phage and the Origins of Molecular Biology*, ed. Cairns, Stent, and Watson, Cold Spring Harbor Laboratory Press, 2007. “The study by Seymour Benzer on the fine structure of the *r*II locus of bacteriophage T4 can be considered the archetype of modern genetic analysis. It was also a major advance in understanding the relationship between the gene and the DNA molecule,” Thomas Brock, *The Emergence of Bacterial Genetics*, Cold Spring Harbor Laboratory Press, 1990, pp. 137-143. “In the audience [at the 1953 Cold Spring Harbor symposium on viruses] was Seymour Benzer, yet another ex-physicist who had heeded the clarion call of Schrödinger’s book. He immediately understood what our breakthrough meant for his studies of mutations in viruses….Within a single astonishingly productive year in his Purdue University lab, Benzer produced a map of a single bacteriophage gene *rII*, showing how a series of mutations—all errors in the genetic script—were laid out linearly along the virus DNA. The language was simple and linear, just like a line of text on the written page,” James D. Watson and Andrew Berry, *DNA: The Secret of Life*, New York: Knopf, 2003, p. 58.

4.Kenneth D. Brown, Yun-Chi Yeh, and Robert W. Holley, “Binding, Internalization, and Degradation of Epidermal Growth Factor by Balb 3T3 and BP3T3 Cells: Relationship to Cell Density and the Stimulation of Cell Proliferation,” (Reprinted from *Journal of Cellular Physiology*, 100:2, Aug. 1979, pp. 227-237.) Holley shared the 1968 Nobel Prize in Physiology or Medicine with Har Gobind Khorana and Marshall W. Nirenberg "for their interpretation of the genetic code and its function in protein synthesis".

5.Michael S. Brown and Joseph L. Goldstein, “Receptor-mediated endocytosis: Insights from the lipoprotein receptor system,” (Reprinted from *Proc. Natl. Acad. Sci. USA*, 76:7, pp. 3330-3337, July 1979.) Brown and Goldstein shared the 1985 Nobel Prize in Physiology or "for their discoveries concerning the regulation of cholesterol metabolism". In addition to explaining the pathology of the link between high levels of circulating cholesterol as LDL and coronary artery disease, they uncovered a fundamental aspect of cell biology -- receptor-mediated endocytosis, the process by which cells internalize molecules or viruses.

6.Edwin Chargaff, "On the Nucleoproteins and Nucleic Acids of Microorganisms," (Reprinted from *Cold Spring Harbor Symposia on Quantitative Biology,* XII [1947]). Chargaff had begun working on nucleic acids in 1946. “When Chargaff discussed the question of gene specificities at Cold Spring Harbor in 1947 he put forward differences in the proportions and the sequences of the bases in nucleic acids as possible grounds for their specificities....Since he expected nature to choose a three-dimensional shape to carry biological specificities he concluded his lecture by describing an experiment in topological replication—the Moebius strip. With this, he said, a child ‘can make many fascinating discoveries about the inheritance of geometrical peculiarities; and when it grows up and remembers them, they may help to take some of the terror from the seemingly automatic nature of the life process,'" Robert Olby, *The Path to the Double Helix,* University of Washington Press (1974), p. 218.

7.Albert Claude, "Fractionation of Mammalian Liver Cells by Differential Centrifugation," Part I and Part II. (Reprinted from *The Journal of Experimental Medicine*, July 1, 1946, Vol. 84, no. 1). A few small manuscript corrections in part I. An important contribution to cell biology. Claude's fractionation studies resulted in four fractions, namely, the nucleus fraction, the "large granules" (secretion granules and mitochondria, the latter containing many components of the respiratory chain), the "small particles" or "microsomes," and the supernatant fraction. Claude shared the Nobel Prize in Physiology or Medicine in 1974 with Christian de Duve and George Emil Palade, "for their discoveries concerning the structural and functional organization of the cell".

8.Edward P. Cohen, M.D. and Harry Eagle, M.D. "A Simplified Chemostat for the Growth of Mammalian Cells: Characteristics of Cell Growth in Continuous Culture, (Reprinted from *The Journal of Experimental Medicine*, Feb. 1, 1961, 113:2, pp. 467-74).

9.S.S. Cohen, M. Sekiguchi, J.L. Stern, and H.D. Barner, "The Synthesis of Messenger RNA Without Protein Synthesis in Normal and Phage-infected Thymineless Strains of *Escherichia coli,* (Reprinted from the *Proceedings of the National Academy of Sciences,* 49:5, pp. 699-707, May, 1963.)

10.Germaine Cohen-Bazire and Jacques Monod, "Physiologie Cellulaire – La compétition entre les ions hydrogène et sodium dans l'activation de la β-D-galactosidase d'*Escherichia coli* et la notion d'antagonisme ionique, "(Extrait des *Comptes rendus des séances de l'Académie des Sciences,* 232, p.1515-1517, 16 Apr. 1951). Jacques Monod won the Nobel Prize in Physiology or Medicine in 1965, sharing it with François Jacob and Andre Lwoff "for their discoveries concerning genetic control of enzyme and virus synthesis".

11.Hans-Diedrich Cremer and Arne Tiselius, "Elektrophorese von Einweiss in Filtrierpapier," (Reprinted from *Biochemische Zeitschrift*, 320, pp. 273-283, 1950). Arne Tiselius was awarded the 1948 Nobel Prize in Chemistry "for his research on electrophoresis and adsorption analysis, especially for his discoveries concerning the complex nature of the serum proteins."

12.C.I. Davern and J. Cairns, "Nucleic Acids and Proteins," (Reprinted from *American Journal of Medicine*, 34, p. 600-608, May 1963) A summary of what was known about the structure and replication of DNA, the transcription of DNA to messenger RNA, the coding of protein by mRNA, and some of the controlling and organizing processes.

13.Berthe Delaporte and L. Siminovitch, "Recherches cytologiques sur un *Bacillus megatherium* lysogène au course du développement du bactériophage," (Extrait des *Annales d L'Institut Pasteur*, Jan. 1952). Work from Andre Lwoff's laboratory group on lysogeny.

14.Max Delbrück, "A Physicist Looks at Biology," [Reprinted from the *Transactions of the Connecticut Academy of Arts and Sciences*, 38. Pp. 173-190, Dec. 1949.] "In this essay, a lecture given at the thousandth meeting of the Connecticut Academy of Arts and Sciences, Delbrück described the spirit of the 1930s and 1940s that moved many of the creators of molecular biology before the *dénouement* brought on by the discovery of the structure of DNA in 1953)," Preface to the first edition of the Delbrück *festschrift, Phage and the Origins of Molecular Biology,* 1966. "Delbrück was was intrigued with the biological implications of [Niels Bohr's principles of] complementarity," Brock p. 118. Delbrück shared the 1969 Nobel Prize in Physiology or Medicine with Salvador Luria and Alfred Hershey for discoveries "concerning the replication method and genetic structure of viruses."

15.Max Delbrück and Gunther S. Stent, "On the Mechanism of DNA Replication," (Reprinted from *The Chemical Basis of Heredity,* edited by William D. McElroy and Bentley Glass. The Johns Hopkins University Press, Baltimore, 1957.) "Gunther Stent was the first to set out these alternative [theories of DNA replication] in a paper he published with Max Delbrück....Proof was a matter for phage and bacterial geneticists," Judson, p. 188. "These theoretical considerations greatly aided the planning and analysis of the phage transfer experiments," Lloyd Kozloff, "Transfer of Parental Material," in *Phage and the Origins of Molecular Biology* (2007), p. 113.

16. M. Demerec, "What is a Gene?" (Reprint from *The Journal of Heredity,* XXIV:10, pp. 368-378, Oct. 1933). Demerec came to Cold Spring Harbor in 1923. He served as Director of the Biological Laboratory from 1941 until his retirement in 1960.

17. M. Demerec, "What is a Gene?"—Twenty Years Later," (Reprint from *The American Naturalist*, LXXXIX:844, pp. 5-20, 1955)

18. Alexander L. Dounce, "Duplicating Mechanism for Peptide Chain and Nucleic Acid Synthesis," (Separatum from *Enzymologia,* XV, 5, pp. 251-258, 1 Sept. 1952). "Early in 1952, Alexander Dounce, at the University of Rochester, put forward a mechanism that addressed both coding and biochemistry....This was the only early venture in theory whose considerable influence Crick acknowledged...the speculative strategy and even the tone are very like things he was writing himself at the time," Judson, pp. 247-248. "In retrospect [this] paper by Dounce appears particularly important. Dounce's paper presented several important ideas that later turned out to be essentially correct. The first was that RNA could serve as a template to direct the synthesis of cell proteins. Another was that the information for the specific arrangement of the amino acids was unique for each protein and came from the specific arrangement of the nucleotides in RNA. A third ... was that each group of three nucleotides in RNA specified a single amino acid," Franklin H. Portugal and Jack S. Cohen, *A Century of DNA*, MIT Press, 1977, p. 274.

19. R. Dulbecco, "The Number of Particles of Bacteriophage T_2 that can Participate in Intracellular Growth," (Reprinted from *Genetics,* 34:126-132, March, 1949.) Early postdoctoral work on the intracellular behavior of phages, with Salvador Luria. Dulbecco received the 1975 Nobel Prize in Physiology or Medicine (shared with David Baltimore and Howard M. Temin) "for their discoveries concerning the interaction between tumour viruses and the genetic material of the cell". The same issue of *Genetics* also contained Luria and Delbecco's "Genetic recombination leading to production of active bacteriophage from ultraviolet inactivated bacteriophage particles," (G-M 2526.1). James Watson was also working on these phage experiments in Luria's lab at Indiana University at this time.

20. S.K. Dutta, A.S. Jones and M. Stacey, "The Separation of Desoxypentosenucleic Acids and Pentosenucleic Acids," (Offprint from *Biochimica et Biophysica Acta*, 10 (1953), pp. 613-622). Ownership stamp of the microbiologist Roger Y. Stanier.

21. Reto Engler and Gerhard Schramm, "Infectious Ribonucleic Acid as Precursor of Tobacco Mosaic Virus," (Reprinted from *Nature,* vol. 183, p. 1277-1279, May 2, 1959). Marginal tears. Schramm had a long and distinguished career studying the tobacco mosaic virus. "The experiments of the German Gerhard Schramm, first published in 1944, reported that TMV particles in mild alkali fell apart into free RNA and a large number of similar, if not identical, protein molecules....I suddenly became enthusiastic about Schramm, for, even if he had misinterpreted the data, by accident he had hit upon the right answer," James D. Watson, *The Double Helix.* Ed. Stent (1980), p. 68.

22. Ugo Fano, "The significance of the hit theory of radiobiological actions," (Reprint from *Jor. App. Physics* 12:347, 1941. Single mimeographed sheet. U.C. Berkeley Genetics Division stamp, deposited by geneticist William Ernest Castle. Fano, a very eminent physicist, worked with Enrico Fermi in Turin and Werner Heisenberg in Leipzig, before emigrating to the United States in 1939. "Fano's American career began with pioneering work in 1940-1944 in what was later to be called radiation biology with M. Demerec and others, at the Department of Genetics of the Carnegie Institution at Cold Spring Harbor. It is noteworthy that, after a seminar in Rome by P. Jordan on x-ray effects on genetic material, Fermi had suggested to Fano that the biological action of radiation would

be an important and suitable topic for study. Fano's papers in this period concerned chromosomal rearrangements, mutations, lethal effects, and genetic effects of X-rays and neutrons on Drosophila melanogaster, as well as theoretical analysis of genetic data. His work also included the discovery of bacteriophage-resistant mutants in Escherichia coli, following up earlier studies by Salvador E. Luria, also a native of Turin, whom Fano had introduced to Fermi's group and who received the Nobel Prize in 1969 together with Max Delbrück and Alfred D. Hershey," Mitio Inokuti, "In Memoriam Ugo Fano," in *rrS News,* XXXIV:1, April 2001.

23. U. Fano, "On the Interpretation of Radiation Experiments in Genetics," (Reprinted from *The Quarterly Review of Biology*, 17:3, pp. 244-252, Sept. 1942).

24. U. Fano and L.D. Marinelli, "Note on the Time-Intensity Factor in Radiobiology," (Reprinted from the *Proceedings of the National Academy of Sciences,* 29:2, pp. 59-66, Feb. 1943.) U.C. Berkeley Genetics Division stamp, deposited by William Ernest Castle.

25. Maurice S. Fox and Rollin D. Hotchkiss, "Initiation of Bacterial Transformation," (Reprinted from *Nature*, 179, pp. 1322-1325, June 29, 1957). Fox and Hotchkiss "discovered that competent cell suspensions would be stored for months in the frozen state, making it possible to carry out detailed studies on the DNA uptake process on uniform populations of cells," Brock, p. 248.

26. H. Fraenkel-Conrat and Robley C. Williams, "Reconstitution of Active Tobacco Mosaic Virus from its Inactive Protein and Nucleic Acid Components," [Reprinted from the *Proceedings of the National Academy of Sciences,* 41:10, October 1955.] G-M 2527 "**first reconstitution of a virus**". "Heinz Fraenkel-Conrat had taken particles of tobacco-mosaic virus apart, which had been done before—and then had successfully put them back together again....Fraenkel-Conrat neutralized the charges that hold the protein subunits together.... He then separated and purified the protein. In a separate, parallel step he he treated virus particles with detergent to strip away the protein to allow the RNA to be recovered. Then he mixed the subunits and the RNA strands in solution once more—and got out normal infectious particles. With the electron microscope Robley William confirmed that the whole virus particles were there. The virus assembled itself: the architecture of the complete particle seemed to be an inbuilt consequence of the structure of the protein subunits," Judson, pp. 299-300.

27. M. Feughelman, R. Langridge, W.E. Seeds, A.R. Stokes, H.R. Wilson, C.W. Hooper, M.H.F. Wilkins, R.K. Barclay, L.D. Hamilton, "Molecular Structure of Deoxyribose Nucleic Acid and Nucleoprotein," (Reprinted from *Nature,* vol. 175, p. 834, May 14, 1955). "Information about the structure of dexoyribose nucleoprotein has been scanty and it has been suggested that deoxyribose nucleic acid may not be closely combined with protein. This communication describes in a preliminary way x-ray diffraction and molecular model-building studies which show that a helical structure of deoxyribose nucleic acid involving the base-pairing of Watson and Crick can be used to explain very satisfactorily a large amount of observed data. It is also shown that deoxyribose nucleoprotein is definitely a compound of protein with nucleic acid".

28. Rosalind E. Franklin and R.G. Gosling, "Evidence for 2-Chain Helix in Crystalline Structure of Sodium Deoxyribonucleate," (Reprinted from *Nature,* vol. 172, p. 156, July 25, 1953). **The first experimental confirmation of the Watson-Crick hypothesis.** "The first independent confirmation of the structure came from Franklin and Gosling.... With the model for structure B in mind, Franklin at last resolved her great difficulties over the Paterson synthesis of structure A. She had the measurements and math in hand, and quickly showed that the A structure, too, fit the sort of model proposed with exactly the changes that the differences in length of the DNA fibres called for," Judson, pp. 186-187. Franklin's last paper concerning DNA.

29. H. Friedrich-Freska, "Genetik und biochemische Genetik in den Instituten der Kaiser-Wilhelm-Gesellschaft und der Max-Planck-Gesellschaft," (Sonderdruck aus *Die Naturwissenschaften*, 48:1, pp. 10-22, 1961). "Heading the Virus Institute [in Munich], though not a bona-fide virologist, was

Friedrich Freska, who speculated before the war on gene duplication in an article that had intrigued me while still a graduate student," James D. Watson, Genes, Girls and Gamow, Oxford University Press, 2001, p. 214.

30. Ernest F. Gale, "Nucleic Acids and Enzyme Synthesis," Reprinted from *Enzymes: Units of Biological Structure and Function*, ed. Gaebler, NY: Academic Press (1956) pp. 49-66. "In the bacterial worlds, the most active laboratories studying cell-free protein and RNA synthesis were Spiegelman's at the University of Illinois...and Ernest Gale's at the University of Cambridge," Brock, p. 304 (citing this paper).

31. Ernest F. Gale, "Nucleic Acids and the Incorporation of Amino Acids," Reprinted from the *Biochemical Society Symposia*, No. 14, 1956, pp. 47-59. "Scientists will remember Ernest Gale for his roles in emphasizing, at an early stage in his career, the chemical and enzymatic basis of microbial activities at a time when many cellular components and biochemicals were ill defined, and secondly for his leadership of a team of colleagues who investigated the molecular basis of antibiotic action and in so doing elucidated many basic aspects of bacterial metabolism," *Biographical Memoirs of the Fellows of the Royal Society,* Dec. 2007.

32. G. Gamow "Possible Relation between Deoxyribonucleic Acid and Protein Structures," (Reprinted from *Nature,* vol. 173, p. 318, February 13, 1954). "One of the earliest attempts to deal with the question [of the mechanism by which the information encoded in DNA was put into operation], other than [Alexander] Dounce's paper was published by the well-known physicist George Gamow....Gamow's initial publication in the biology field proposed that the question of the genetic code came about through the fitting of specific amino acids into the rhombic-shaped holes formed between the intertwined strands of DNA," Portugal and Cohen, *A Century of DNA*, p. 285. "[I]t was the cosmologist, George Gamow, who began to air his views on the nature of the code and on the relationship between DNA and the amino acids privately to Watson and Crick in the summer of 1953, and publicly in his note in *Nature* for February 13, 1954....Like Watson and Crick, Gamow was assuming that the bases remained paired during transcription," Olby, pp. 430-431. Ownership stamp of the distinguised Canadian microbiologist R.Y. Stanier.

33. Beatrice B. Garber and A.A. Moscona, "Reconstruction of Brain Tissue from Cell Suspensions," (Parts I and II). (Reprinted from *Developmental Biology*, 27, pp. 217-234 and 235-243, 1972). Each inscribed by Garber. Important studies on cell aggregation and adhesion.

34. Walter Gilbert and David Dressler, "DNA Replication: The Rolling Circle Model" Cold Spring Harbor Symposium, 1968. Mimeographed, stapled. Gilbert and Dressler discovered one of the two ways in which DNA molecules duplicate themselves. Gilbert shared the 1980 Nobel Prize in Chemistry with Frederick Sanger "for their contributions concerning the determination of base sequences in nucleic acids."

35. A. Goffeau and J. Brachet. "Deoxyribonucleic acid-dependent incorporation of amino acids into the proteins of chloroplasts isolated from anucleate *Acetabuliaria* fragments," Reprinted from *Biochemica et Biophysica Acta,* 95, pp. 302-313 (1965). André Goffeau and Jean Brachet showed that isolated chloroplasts from anucleate *Acetabularia* fragments are able to synthesize proteins from their own DNA.

36. Lester Goldstein and Walter Plaut, "Direct Evidence for nuclear synthesis of cytoplasmic ribose nucleic acid," (Reprinted from *Proceedings of the National Academy of Sciences* 41, 874–880 Nov., 1955). "Goldstein and Walter Plaut devised a clever strategy that allowed them to [determine whether RNA actually moved from the nucleus to the cytoplasm] through examination of the relationship between nuclear and cytoplasmic RNA in amoebas," Ralston, A. & Shaw, K. (2008) *mRNA: history of functional investigation. Nature Education 1(1)*. R.Y. Stanier's copy with his initials.

37. H. Green and H.S. Anker, "On the Synthesis of Antibody Protein," [Reprinted from *Biochimica and*

Biophysica Acta 13, pp. 365-373, 1954]. The first study of antibody synthesis during the period of induction.

38. Marianne Grunberg-Manago, Priscilla J. Ortiz, Severo Ochoa. "Enzymatic Synthesis of Nucleic Acidlike Polynucleotides," (Reprinted from *Science*, Nov. 11, 1955.) "they thought they had found the enzyme responsible for assembling RNA in the living cell. The identification was mistaken....," Judson, p. 298. Ochoa shared the 1959 Nobel Prize in Physiology or Medicine with Arthur Kornberg, "for their discovery of the mechanisms in the biological synthesis of ribonucleic acid and deoxyribonucleic acid".

39. Leslie A. Holladay, C. Richard Savage, Jr., Stanley Cohen, and David Puett, "Conformation and Unfolding Thermodynamics of Epidermal Growth Factor and Derivatives," [Reprinted from *Biochemistry* (1976) 15, pp. 2624-2633]. Stanley Cohen isolated epidermal growth factor in 1962. He shared the 1986 Nobel Prize in Physiology or Medicine with Rita Levi-Montalcini “"for their discoveries of growth factors".

40. Rollin D. Hotchkiss and Esther Weiss, "Transformed Bacteria," (Reprinted from *Scientific American*, Nov. 1956). "Rollin Hotchkiss, who had been in [O.T.] Avery's laboratory or that of his student Dubos since the mid-1930s, began work on the transforming principle after [Avery's collaborator Maclyn] McCarty's move [to the Rockefeller Institute]. Hotchkiss and his own students were responsible for many of the most important advances in knowledge of the transforming principle in the post-World-War-II period" Brock, p. 240.

41. R.D. Hotchkiss and Elena Ottolenghi, "Genetic Transformation as a Basis for Evolution in Bacteria," (Reprinted from *Proceedings of the Fifth International Congress of Biochemistry*, Pergamon Press, 1963.

42. François Jacob, "Chimie Biologique – Suppression expérimentale de la croissance des bactéries au cours du développement du bactériophage chez *Pseudomonas pyocyanea*," (Extrait des *Comptes rendus des séances de l'Académie des Sciences,* 232, p. 1605-1607, 23 Apr. 1951). "[T]he technique of induction was to be used extensively in an anlysis of the nature of of lysogeny. François Jacob carried out extensive research for his [1954] doctoral thesis with the bacterium *Pseudomonas pyocyanea* bacterium," Brock, p. 178. The Nobel Prize in Physiology or Medicine 1965 was awarded jointly to Jacob, André Lwoff and Jacques Monod "for their discoveries concerning genetic control of enzyme and virus synthesis".

43. François Jacob, Louis Siminovitch, and Élie Wollmann, "Chimie Biologique – Induction de la production d'une colicine par le rayonnement ultraviolet" (Extrait des *Comptes rendus des séances de l'Académie des Sciences,* 233, p. 1500-1502, 3 Dec. 1951).

44. François Jacob, Anne-Marie Torriani, and Jacques Monod, " Physiologie cellulaire – L'effet du rayonnement ultraviolet sur la biosynthèse de la β-galactosidase et sur la multiplication du bactériophage T2 chez *Escherichia coli*," (Extrait des *Comptes rendus des séances de l'Académie des Sciences,* 233, p. 1230-1232, 12 Nov. 1951).

45. Herbert Jehle, "Replication of Double-Strand Nucleic Acids," (Reprinted from the *Proceedings of the National Academy of Sciences* 53:6, June 1955.) The physicist Jehle's work on van der Waals forces led to his interest and contributions to the mechanisms for DNA replication and protein synthesis. During this time, he was a consultant to Marshall Niremberg in the early DNA-to-protein coding problem.

46. Herman Kalckar, "Inhibitory Effect of Phloridzin on an Enzymic Dismutation," (Reprinted from *Nature,* vol. 136, p. 872, November 30, 1935). "Kalckar's biochemical contributions were multifaceted.His

initial work opened an investigative pathway to what has come to be called oxidative phosphorylation. As a mature investigator, his utilized his laboratory to play a significant role in the rapidly evolving field of enzymology,and Kalckar introduced innovative ways of measuring enzymatic activity. A significant part of his enzymological work focused on galactose metabolism, and he was one of the first investigators to clarify the nature of the genetic disorder galactosemia. Like many twentieth-century biochemists, Kalckar did not restrict his work to any single organism or tissue, and he contributed equally to the understanding of microbial physiology and human diseases," R. Singleton, Jr. "Kalckar, Herman Moritz." In *New Dictionary of Scientific Biography*, edited by Noretta Koertge, vol. 4, 71-76. Detroit: Charles Scribner's Sons. 2007.

47. Herman Kalckar, "Inhibitory Effect of Phloridzin and Phloretin on Kidney Phosphatase," (Reprinted from *Nature,* vol. 138, p. 289, August 15, 1936).

48. Herman Kalckar, "The significance of phosphorylation in kidney tissue," (Sonderdruck aus *Skandinavisches Archiv fur Physiologie*, Band 77) [1937]

49. Herman Kalckar, "Mechanism of Fructose Resorption in Intestine and Kidney," (Reprinted from *Nature,* vol. 142, p. 76, July 9, 1938)

50. Herman Kalckar, "Formation of a New Phosphate Ester in Kidney Extracts," (Reprinted from *Nature,* vol. 142, p. 871, November 12, 1938)

51. Herman Kalckar, "Phosphorylations in Kidney Cortex," Review from a Dissertation. Copenhagen: Nyt Nordisk Forlag, 1938.

52. Herman Kalckar, "The Nature of Energetic Coupling in Biological Syntheses," (Reprinted from *Chemical Reviews*, 28:1, February, 1941). Signed by Kalckar. "Most likely from his familiarity with Bohr's atomic concepts, Kalckar was influenced by the potential impact of Pauling's chemical ideas on biological problems. At Pauling's encouragement, Kalckar wrote an extensive review in which he developed many of our modern concepts of bioenergetics, including the notion that oxidation reactions are 'coupled' to phosphorylation reactions via ATP. Although not widely appreciated at the turn of the twenty-first century, Kalckar's 1941 *Chemical Reviews* paper influenced the way many scientists thought about the energetics of life processes," Singleton. "Perhaps one can say that the discovery of the coupling of the biosynthesis of acylphosphates to the 'dry' dehydrogenation of carbonyl compounds marked the beginning of molecular biology, at least as far as explaining the mechanism of the generation of enery in the living cell," Kalckar, "High Energy Phosphate Bonds: Optional or Obligatory?" in *Phage and the Origins of Molecular Biology.*

53. Herman Kalckar, "Mesomeric Concepts in the Biological Sciences," (Reprinted from *Currents in Biochemical Research*, Edited by D.E. Green, New York, 1946).

54. Herman Kalckar, "Aspects of the Biological Function of Phosphate in Enzymatic Syntheses," (Reprinted from *Nature,* vol. 160, p. 143, August 2, 1947).

55. J.C. Kendrew, G. Bodo, H.M. Dintzis, R.G. Parrish, H. Wyckoff, and D.C. Phillips, "A Three-dimensional Model of the Myoglobin Molecule Obtained by X-ray Analysis". (Reprinted from *Nature* 181 (4610): 662–6 Mar. 8, 1958). Myoglobin was the first protein to have its three-dimensional structure revealed. In 1958, John Kendrew and his associates determined its structure by high-resolution X-ray crystallography. Kendrew shared the 1962 Nobel Prize in chemistry with Max Perutz "for their studies of the structures of globular proteins". See Judson, pp. 561-564.

56. J.L. Kent, M. Roger, and R.D. Hotchkiss, "On the Role of Integrity of DNA Particles in Genetic Recombination During Pneumococcal Transformation," (Reprinted from the *Proceedings of the National Academy of Sciences,* 50:4, pp. 717-725, Oct. 1963)

H.G. Khorana and associates (items 56-76). H.G. Khorana shared the 1968 Nobel Prize in Physiology or Medicine with Robert W. Holley and Marshall W. Nirenberg "for their interpretation of the genetic code and its function in protein synthesis," research that helped to show how the nucleotides in nucleic acids, which carry the genetic code of the cell, control the cell's synthesis of proteins. From 1952-1960 he was at the University of British Columbia. In this series of papers published during the 1950s and 1960s he introduced chemical approaches to nucleic acid synthesis and sequence analysis, establishing the basic techniques of nucleotide chemistry.

57.H.G. Khorana, "Carbodiimides. Part V. A Novel Synthesis of Adenosine Di- and Triphosphate and P^1, P^2-Diadenosine-5'-pyrophosphate," [Reprinted from the *Journal of the American Chemical Society*, 76, 3517 (1954)].

58.Charles A. Dekker and H.G. Khorana. , "Carbodiimides. VI. The Reaction of Dicyclohexylcarbodiimide with Yeast Adenylic Acid. A New Method for the Preparation of Monoesters of Ribonucleoside 2' and 3'-Phosphates" [Reprinted from the *Journal of the American Chemical Society*, 76, 3522 (1954)].

59.Ross H. Hall and H.G. Khorana "Nucleoside Polyphosphates II. A Synthesis of Uridine-5'di- and –Triphosphate," [Reprinted from the *Journal of the American Chemical Society*, 76, 5056 (1954)].

60.Ross H. Hall and H.G. Khorana "Nucleoside Polyphosphates III. Syntheses of Pyrimidine Nucleoside-2'(3'),5'-diphosphates," [Reprinted from the *Journal of the American Chemical Society*, 77, 1871 (1955)].

61.Robert Warner Chambers, J.G. Moffatt and H.G. Khorana, "The Synthesis of Guanosine-5'-Phosphate Using a New Method of Phosphorylation, ," [Reprinted from the *Journal of the American Chemical Society*, 77, 3416 (1955)].

62.R.S. Wright and H.G. Khorana, "A Synthesis of beta-D-Ribofuranose-1-phosphate," [Reprinted from the *Journal of the American Chemical Society*, 77, 3423 (1955)]

63.G.M. Tener and H.G. Khorana, "Cyclic Phosphates. II. Further Studies of Ribonucleoside 2': 3'-Cyclic Phosphates" [Reprinted from the *Journal of the American Chemical Society*, 77, 5349 (1955)]. Inscribed by Khorana.

64.G.M. Tener, R.S. Wright and H.G. Khorana, "A Synthesis of α-D-Ribofuranose-1-phosphate," [Reprinted from the *Journal of the American Chemical Society*, 78, 506 (1956)]

65.R.S. Wright and H.G. Khorana, "Phosphorylated Sugars. I. A Synthesis of β-D-Ribofuranose-1-phosphate," [Reprinted from the *Journal of the American Chemical Society*, 78, 811 (1956)]

66.H.G. Khorana, G.M. Tener, R.S. Wright and J.G. Moffatt, "Cyclic Phosphates III. Some General Observations on the Formation and Properties of Five-, Six, and Seven-membered Cyclic Phosphate Esters. [Reprinted from the *Journal of the American Chemical Society*, 79, 430 (1957)]

67.G.M. Tener and H.G. Khorana, "Phosphorylated Sugars. II. The Preparation of the Anomeric Methyl 5-O-Benzyl-D-ribofuranoside 2,3-Cyclic Carbonates and the Study of their Reactions with Hydrogen Bromide in Acetic Acid, [Reprinted from the *Journal of the American Chemical Society*, 79, 437 (1957)]

68.G.M. Tener, R.S. Wright and H.G. Khorana, "Phosphorylated Sugars. III. Syntheses of alpha-D-Ribofuranose 1-Phosphate, [Reprinted from the *Journal of the American Chemical Society*, 79, 441

(1957)]

69.H.G. Khorana, W.E. Razzell, P.T.Gilham, G.M. Tener and E.H. Pol, “Syntheses of Dideoxyribonucleotides,” [Reprinted from the *Journal of the American Chemical Society*, 79, 1002 (1957)]

70.J.G. Mofatt and H.G. Khorana. , “Carbodiimides. VII. Tetra-ρ-nitrophenyl Pyrophosphate, a New Phosphorylating Agent. [Reprinted from the *Journal of the American Chemical Society*, 79, 3741 (1957)]

71.Robert Warner Chambers and H.G. Khorana, “Nucleoside Polyphosphates. V. Syntheses of Guanosine 5’-Di and Triphosphates,” [Reprinted from the *Journal of the American Chemical Society*, 79, 3752 (1957)].

72.Robert Warner Chambers, J.G. Moffatt and H.G. Khorana, “Nucleoside Polyphosphates. IV. A New Synthesis of Guanosine-5’-Phosphate,” [Reprinted from the *Journal of the American Chemical Society*, 79, 3747 (1957)].

73.W.E. Razzell and H.G. Khorana, “The Stepwise Degradation of Thymidine Oligonucleotides by Snake Venom and Spleen Phosphodiesterases,” [Reprinted from the *Journal of the American Chemical Society*, 80, 1770 (1958)].

74.Robert Warner Chambers and H.G. Khorana, “Nucleoside Polyphosphates. VII. The Use of Phosphoramidic Acids in the Synthesis of Nucleoside-5’ Pyrophosphates” [Reprinted from the *Journal of the American Chemical Society*, 80, 3749 (1958)].

75.J.G. Moffatt and H.G. Khorana, “Nucleoside Polyphosphates. VIII. New and Improved Syntheses of Uridine Diphosphate Glucose and Flavin Adenine Dinucleotide Using Nucleoside-5’ Phosphoramidates” [Reprinted from the *Journal of the American Chemical Society*, 80, 3756 (1958)].

76.G.M. Tener and H.G. Khorana, “Phosphorylated Sugars. VI. Syntheses of alpha-D-Ribofuranose 1,5-Diphosphate and alpha-D-Ribofuranose 1-Pyrophosphate 5-Phosphate,” [Reprinted from the *Journal of the American Chemical Society*, 80, 1999 (1958)]

77.R.K. Ralph, R.A. Smith, and H.G. Khorana, “Studies on Polynucleotides XV. Enzymic Degradation. The Mode of Action of Pancreatic Deoxyribonuclease on Thymidine, Deoxycytidine, and Deoxyadenosine Polynucleotide,” [Reprinted from *Biochemistry* 1, 131 (1962)]

78.Lloyd E. King, Jr., Graham Carpenter, and Stanley Cohen, ‘‘Characterization by Electrophoresis of Epidermal Growth Factor Stimulated Phosphorylation Using A-431 Membranes,’’ (Reprinted from *Biochemistry* (1980), 19, pp. 1524-1528). Stanley Cohen isolated epidermal growth factor in 1962. He shared the 1986 Nobel Prize in Physiology or Medicine with Rita Levi-Montalcini “for their discoveries of growth factors.”

79.Joshua Lederberg, “Gene Recombination and Linked Segregations in Escherichia Coli,” (Reprinted from *Genetics* 32: pp. 505-525, Sept. 1947). This abstract from Lederberg’s doctoral dissertation offered the first genetic map of *Escherichia coli.* Lederberg won the 1958 Nobel Prize in Physiology or Medicine "for his discoveries concerning genetic recombination and the organization of the genetic material of bacteria," sharing it with Edward L. Tatum and George Beadle. Cf. Judson, pp. 369 (note p. 651). Brock, pp. 84-86.

80.André Lwoff and Antoinette Gutmann, “Microbiologie – Les problèmes de la production du bactériophage par les souches lysogène. La lyse spontanée du *Bacillus megatherium*,” (Extrait des *Comptes rendus des séances de l’Académie des Sciences,* 229, pp. 605-607, 19 Sept. 1949).

"Rarely can it be said that the studies of a single scientist have changed the complete course of subsequent work, but this can be said about lysogeny and Andre Lwoff. Until Lwoff's work, fuzzy thinking and weak experiments had dominated the field of lysogeny…Even the Delbruck phage group had misunderstood [its] essential nature. This confusion was all to end as a result of the brilliant work of Andre Lwoff. It is now hard to appreciate the revolutionary impact of Lwoff's simple experiments," Brock, pp. 170. The Nobel Prize in Physiology or Medicine 1965 was awarded jointly to François Jacob, André Lwoff and Jacques Monod "for their discoveries concerning genetic control of enzyme and virus synthesis".

81. André Lwoff and Antoinette Gutmann, "Microbiologie – La perpétuation endomicrobienne du bactériophage un chez *Bacillus megatherium* lysogène," (Extrait des *Comptes rendus des séances de l'Académie des Sciences,* 229, pp. 789-791, 17 Oct. 1949). See Brock, pp. 174-176.

82. André Lwoff and Antoinette Gutman, "Microbiologie – La libération de bactériophage par la lyse d'une bactérie lysogène," (Extrait des *Comptes rendus des séances de l'Académie des Sciences,* 230, p. 154-156, 2 Jan 1950).

83. André Lwoff, Louis Siminovitch and Niels Kjeldgaard, "Microbiologie – Induction de la lyse bactériophagique de la totalité d'une population microbienne lysogène," (Extrait des *Comptes rendus des séances de l'Académie des Sciences,* 231, p. 190-191, 10 July 1950).

84. André Lwoff, Louis Siminovitch and Niels Kjeldgaard, "Microbiologie – Induction de la production de bactériophages chez une bactérie lysogène," (Extrait des *Annales de L'Institut Pasteur*, Dec. 1950). **The discovery of induction. "**The discovery of induction was of the greatest importance for understanding the nature of lysogeny,….Using induction, phage replication could be studied in a manner similar to that of virulent phage production. It was induction that was to convince Delbruck that lysogeny was a 'real' phenomenon," Brock, pp. 176-79. Lwoff called this "the greatest thrill—molecular thrill—of my scientific career." "A new definition of virus had also been turned loose--an unsettling definition that said that viruses are sometimes far more intimately and permanently associated with the genetic material of their host cells than had ever been imagined," Judson, pp. 374-5.

85. André Lwoff and Louis Siminovitch, "Chimie Biologique – Induction par des substances réductrices de la production de bactériophages chez une bactérie lysogène," (Extrait des *Comptes rendus des séances de l'Académie des Sciences,* 232, p. 1146-1147, 12 Mar. 1951). "Induction with ultra-violet light triggered a new series of experiments. It was finally found that thioglycolic acid and a number of other reducing substances are powerful inducers," Andre Lwoff, "The Prophage and I," in *Phage and the Origins of Molecular Biology* p.94.

86. André Lwoff and Louis Siminovitch, "Chimie Biologique – Induction de la lyse d'une bactérie lysogène sans production de bactériophage," (Extrait des *Comptes rendus des séances de l'Académie des Sciences,* 233, p. 1397-1399, 26 Nov. 1951). "The prophage is a potentially lethal factor. However some lysogenic bacteria perpetuate an abnormal prophage. Induction triggers the vegetative phase: the bacterium lyses, but no virons are produced," Lwoff, "The Prophage and I," p.95

87. André Lwoff, "Conditions de l'efficacité inductrice du rayonnement ultra-violet chez une bactérie lysogène," (Extrait des *Annales d L'Institut Pasteur*, Oct. 1951)

88. André Lwoff, "Chimie Biologique – Rôle des cations bivalents dans l'induction du développement du prophage par les agents rédacteurs," (Extrait des *Comptes rendus des séances de l'Académie des Sciences,* 234, pp. 366-368, Jan. 1952).

89. André Lwoff, "Nutrition and Metabolism in Fields Collateral to Tissue Culture," (Reprinted from the *Journal of the National Cancer Institute* 19:4, 1957). Ownership signature of [Lloyd] Kozloff.

90. Franklin C. McLean, "Application of the Law of Chemical Equilibrium (Law of Mass Action) to Biological

Problems," (Reprinted from *Physiological Review*, 18:4, pp. 495-523, Oct. 1938). "So far as the author is aware this is the first attempt to review the contributions of the law of chemical equilibrium to the study of biological problems....It should be increasingly useful as biology becomes more and more concerned with the analysis of chemical processes in the living organism." McLean was founding dean of both the Peking Union Medical College and the University of Chicago Medical School. A renowned bone physiologist, he was the first to measure glucose in the blood.

91.R. Markham and J.D. Smith, "Chromotographic Studies of Nucleic Acids. 1. A Technique for the Identification and Estimation of Purine and Pyrimidine Bases, Nucleosides and Related Substances," (Reprinted from *The Biochemical Journal*, 45:3, pp. 294-298, 1949). Inscribed "Dr. La Roche with compliments." Markham's work with the tobacco mosaic virus at the Molteno Institute was the ostensible reason (given on his fellowship application) for James D. Watson's presence in Cambridge.

92.R. Markham and J.D. Smith, "Chromotographic Studies of Nucleic Acids.. 4. The Nucleic Acid of the Turnip Yellow Mosaic Virus, Including a note on the Nucleic Acid of the Tomato Bushy Stunt Virus," (Tearsheets from *The Biochemical Journal* 51, pp. 401-407, 1951).

93.M. Meselson and F.W. Stahl. "The Replication of DNA in Escherichia coli," (Reprinted from the *Proceedings of the National Academy of Sciences,* 44:7, July 1958.). Using density gradient analysis, Meselson and Stahl provided the first proof of semi-conservative replication of DNA, as predicted by Watson and Crick's double helix model. G-M 256.6 "The work it describes is now recognized as displaying the most rare technical skill....Meselson's and Stahl's paper possessed an importance and authority like that of Oswald Avery's announcement, fourteen years earlier, of the transforming principle and its identification as DNA. 'Classic' was Watson's epithet...John Cairns...described Meselson's central demonstration without qualification as 'the most beautiful experiment in biology," Judson, p. 188. "Many landmark experiments in the history of science are eventually described as classic. To have obtained that status less than five years after its publication makes the Meselson-Stahl experiment exceptional," Holmes, *Meselson, Stahl, and the Replication of DNA*,Yale University Press, 2001 p. 397. "There remained, however, a single missing piece in the double helicaljigsaw puzzle: our unzipping idea for DNA replication had yet to be experimentally verified Max Delbrück… worried that unzipping it might generate horrible knots. Five years later, a former student of Pauling's, Matt Meselson, and the equally bright young phage worker Frank Stahl put to rest such fears when they published the results of a single elegant experiment," Watson and Berry, p. 58-61.

94.M. Meselson and F.W. Stahl. "The Replication of DNA," (Reprinted from *Cold Spring Harbor Symposia on Quantitative Biology,* XXIII, 1958, pp. 9-12). The authors' *PNAS* paper "The Replication of DNA in Escherichia coli," is listed as "in press". The Symposium took place in June, 1958. For this paper "Meselson and Stahl dropped the approach they had worked so long to establish in their *PNAS* paper...they transformed the role of their experiment into a 'direct experimental test' of the Watson-Crick hypothesis. The statements that they had presented in the *PNAS* paper as conclusions to be drawn from the experiment...they now treated, in compressed form, as 'striking predictions' that the Watson-Crick hypothesis makes concerning its outcome," (Holmes, p. 389).

95.Leonard Mindich and Rollin D. Hotchkiss, ''The Fractionation of Pneumococcal Genetic Transforming Activity,'' and "Chromotographic Fractionation of Bacterial Deoxyribonucleic Acid. (Reprinted from *Biochimica et Biophysica Acta*, 80 (1964), pp. 73-109)

96.Jacques Monod, Anne-Marie Torriani, and Madeleine Jolit, "Biochimie Bactérienne – Sur la réactivation de bactéries stéerilisées par le rayonnement U.V.," "(Extrait des *Comptes rendus des séances de l'Académie des Sciences,* 229, p. 557-559, Sept. 12, 1949). "In the post-World-War-II period, the most influential figure in research on gene expression was Jacques Monod," Brock, p. 275. The Nobel Prize in Physiology or Medicine 1965 was awarded jointly to François Jacob, André Lwoff and Jacques Monod *"for their discoveries concerning genetic control of enzyme and virus* *synthesis"*.

97. Jacques Monod, "Adaptation, Mutation and Segregation in the Formation of Bacterial Enzymes," (Reprinted from the *Biochemical Society Symposia*, No. 4, 1950). "The basic question is, whence does the molecule derive its specific structure? In the case of 'biosynthetic' enzymes, there is no experimental evidence to contradict the hypothesis that a specific gene may be entirely responsible for it. But in the case of adaptive enzymes, there is proof that the substrate plays an important and decisive part in the synthesis, although specific genes are implicated in determining the competence to adapt."

98. Jacques Monod, Germaine Cohen-Bazire and Melvin Cohn, "Sur la biosynthese de la β-galactosidase (lactase) chez *Escherichia coli.* La specificite de l'induction," (Extract from *Biochimica et Biophysica Acta*, Vol 7, 1951, pp. 585-599. The discovery of galactosides. Cf. Judson, p. 383 (note p. 652). "[T]he existence of nonsubstrate inducers ruled out any direct connection between the β-galactoside as substrate and as inducer. This discovery had a profound philosophical impact on Monod, for it ruled out any teleological explanation of enzyme adaptation. This led to a new term, *induction,* to replace the philosophically 'loaded' term *adaptation….*Gratuitous induction made it possible to study enzyme synthesis separately from enzyme function, thus making the study of kinetics more meaningful," Brock p. 284

99. Hans Neurath, "The Investigation of Proteins by Diffusion Measurements," (Reprinted from *Chemical Reviews*, 30:3, June, 1942, pp. 357-394, figs. Neurath was among the first to apply modern physical and chemical techniques in examining the composition and function of proteins. The Protein Society's award is named for him.

100. A.Novick and Leo Szilard, "Experiments on Light-Reactivation of Ultra-Violet Inactivated Bacteria," [Reprinted from the *Proceedings of the National Academy of Sciences* 35:10, pp. 591-600, October 1949]

101. Aaron Novick and Leo Szilard, "Description of the Chemostat," (Reprinted from *Science*, Dec. 15, 1950, 112: 2920, pp. 715-716.) The invention of this device "for keeping a bacterial population growing at a reduced rate over an indefinite period of time."

102. A.Novick and Leo Szilard, "Experiments with the Chemostat on Spontaneous Mutations of Bacteria" [Reprinted from the *Proceedings of the National Academy of Sciences* 36:12, pp. 708-719, Dec. 1950]. "We realized that the chemostat could be used not only for the physiological studies for which it was invented but also for an accurate measure of mutation rate. Our first finding, namely that the spontaneous mutation rate is a constant per hour...was intriguing but understandable neither then nor subsequently," Novick, "Phenotypic Mixing," in *Phage and the Origins of Molecular Biology* .

103. Aaron Novick and Leo Szilard, "Experiments on Spontaneous and Chemically Induced Mutations of Bacteria Growing in the Chemostat," (Reprinted from *Cold Spring Harbor Symposia on Quantitative Biology*, XVI, 1951). "In [this] important paper, Novick and Szilard presented data for both spontaneous and chemically induced mutation. The spontaneous mutation rates obtained were similar to those obtained by Luria and Delbrück." Brock, p. 62.

104. Aaron Novick and Leo Szilard, "Anti-mutagens," (Reprinted from *Nature,* vol. 170, p. 926, Nov. 29, 1952).

105. Aaron Novick and Leo Szilard, "Experiments with the Chemostat on the Rates of Amino Acid Synthesis in Bacteria, (Reprinted from *Dynamics of Growth Process*, Princeton University Press, 1954). "During our studies of mutagenesis in the chemostat we found ... [indications] that an amino acid can inhibit its own formation by a direct effect on one or more enzymes in its biosynthetic pathway," Novick, "Phenotypic Mixing".

106.Linus Pauling and Dan H. Campbell, “The Production of Antibodies in Vitro,” [Reprinted from *Science* 95:2469, pp. 440-441, April 24, 1942].

107.Linus Pauling and Dan H. Campbell, “The Manufacture of Antibodies in Vitro,” [Reprinted from *The Journal of Experimental Medicine*, 76:2, pp. 211-220, August 1, 1942].

108.Linus Pauling, Dan H. Campbell and David Pressman, “The Nature of the Forces Between Antigen and Antibody and of the Precipitation Reaction,” [Reprinted from *Physiological Review*, 23:3, pp. 203-219, July, 1943].

109.Linus Pauling and Robert B. Corey, "A Proposed Structure for the Nucleic Acids," (Reprinted from the *Proceedings of the National Academy of Sciences,* 39:2, February, 1953.) Their proposal involved three intertwined helical chains. "To read a paper by a great scientist that's all wrong is an odd exercise...it...prompts a kind of historical meditation that scientists might try with profit both to their sense of method, and to their vanity...Although it has ever after been thought of as Pauling's structure for DNA...the paper appeared to claim a structure correct for the nucleic acids generally," Judson, pp. 156-7.

110.Linus Pauling and Robert B. Corey, "Specific Hydrogen-Bond Formation between Pyrimidines and Purines in Deoxyribonucleic Acids," (Reprinted from *Archives of Biochemistry and Biophysics*, 65:1, 164-181, November 1956.) The possibility of three hydrogen bonds in the DNA molecule "was made almost certain by the theoretical arguments of Pauling and Corey and was confirmed by X-ray structure determinations of single crystals of base pairs," Francis Crick, "The Double Helix: A Personal View,"in *Nature* 248, 766 - 769 (26 April 1974).

111.Linus Pauling, “Chemical Achievement and Hope for the Future,” (Reprinted from *American Scientist*, Winter 1948, 36: 1, pp. 50-58). Based on his Silliman Lecture at Yale University.

112.Linus Pauling, “Molecular Structure and Biological Specificity,” in *XI International Congress of Pure & Applied Chemistry. Congress Lectures*, London, Supplement to “Chemistry & Industry,” 1948. The whole issue, this is not an offprint. Also contains: P. Karrer “Some recent results in organic chemisty,” A. Tiselius, “Recent developments in electrophoresis,” et al.

113.Linus Pauling, “Quantum Theory and Chemistry,” (Reprinted from *Science,* 113:2926, pp. 92-94, Jan. 26, 1951).

114.Linus Pauling, “The Structure of Water,” (Reprinted from *Hydrogen Bonding.* Papers presented at Ljubljana, 29 July-3 August 1957. Pergamon Press. Pp. 1-6).

115.Linus Pauling, “A Molecular Theory of General Anesthesia,” (Reprinted from *Science*, July 7, 1961, 134:3471, pp. 15-21).

116.H.K. Schachman and W.F. Harrington, “Ultracentrifuge Studies with a Synthetic Boundary Cell. I. General Applications,” (Reprinted from *Journal of Polymer Science*, XII:67, pp. 379-390, Jan. 1954). “Schachman achieved wide recognition for his technical ingenuity in extending the range of questions that could be answered using the analytical ultracentrifuge....[H]is invention of the synthetic boundary cell, in collaboration with Pickels...enabled the study of the sedimentation of smaller molecular weight materials...than had been previously possible,” Angela N. H. Creager, *The life of a virus: tobacco mosaic virus as an experimental model, 1930-1965,* University of Chicago Press, 2002, p. 261

117.V.N. Schumacker and H.K. Schachman, “Ultracentrifugal Analysis of Dilute Solutions,” (Offprint from *Biochimica et Biophysica Acta*, 23, pp. 628-639, 1957).

118. Louis Siminovitch "Chimie Biologique -- Relation entre le développement abortif du prophage chez *Bacillus megatherium* 91 (1) et la synthèse de l'acide désoxyribonucléique," (Extrait des *Comptes rendus des séances de l'Académie des Sciences,* 233, p. 1694-1696, 19 December 1951). Siminovitch, a pioneering Canadian molecular biologist, after receiving his doctorate, worked with Andre Lwoff at the Pasteur Institute in Paris.

119. Louis Siminovitch and Sarah Rapkine, "Chimie Biologique – Modifications biochimiques au cours du développement des bactériophages chez une bactérie lysogène," (Extrait des *Comptes rendus des séances de l'Académie des Sciences,* 232, p. 1603-1605, 23 April 1951).

120. Gunther Stent, "Genetic Transcription," (Reprinted from the *Proceedings of the Royal Society*, B., volume 164, pp. 181-197, 1966).

121. Gunther Stent, "What They are Saying About Honest Jim," (Reprinted from *Quarterly Review of Biology*, 43:2, pp. 179-184, June 1968). A review of the reviews of Watson's *The Double Helix*.

122. Earl W. Sutherland and T.W. Rall, "The Properties of an Adenine Ribonucleotide Produced with Cellular Particles, ATP, MG^{++}, and Epinephrine or Glucagon," [Reprinted from the *Journal of the American Chemical Society*, 79, 3608 (1957)]. The adenine ribonucleotide was adenosine 3′,5′-monophosphate, now commonly referred to as cyclic AMP or cAMP. Sutherland's discovery and chemical characterization of the cAMP intermediate or "second messenger" was of crucial importance for understanding the mechanism of action of epinephrine and of many other hormones and he was awarded the 1971 Nobel Prize in Physiology or Medicine "for his discoveries concerning the mechanisms of the action of hormones."

123. Harry Svensson, "Electrophoresis by the Moving Boundary Method: A Theoretical and Experimental Study," *Arkiv för Kemi, Mineralogi och Geologi,* 22:10 (whole issue) Stockholm, 1946. Spine worn. Inscribed by the author. Svensson (who later changed his name to Rilbe) made important contributions to separation science, working on moving boundary electrophoresis under Arne Tiselius, and later on isoelectric focusing.

124. Leo Szilard "The Control of the Formation of Specific Proteins in Bacteria and in Animal Cells," The Enrico Fermi Institute for Nuclear Studies, The University of Chicago, 29 page mimeo, probably produced prior to publication in *Proc Natl Acad Sci U S A*; 46(3): 277–292, March 1960. "No text of Szilard's talk [in October 1957, presenting his model of enzyme synthesis, based on induction and repression] appears to survive, so the one source is his reference to the sequence of the discussion, and to his Berlin talk, in Leo Szilard "The Control of the Formation of Specific Proteins in Bacteria and in Animal Cells," Judson, p. 654. "It appears that at this time Monod was still thinking of an 'instructive' role for the inducer, and it was only after Leo Szilard suggested a negative repression model [in this paper] that Monod became enthusiastic for it....," Brock, p. 293.

125. Leo Szilard, "The Molecular Basis of Antibody Formation," Chicago: The Enrico Fermi Institute for Nuclear Studies. Mimeograph, 18 pp. [1960]. Later [?] published in *PNAS.* Szilard here applied his theory of enzyme synthesis to the production of antibodies in vertebrates.

126. E.L. Tatum and Joshua Lederberg, "Gene Recombination in the Bacterium Escherichia Coli," (Reprinted from *Journal of Bacteriology,* 53:6, pp. 673-684, June, 1947). "The first complete paper on the subject [of bacterial mating]," Brock, p. 84. (Lederberg and Tatum's 1946 paper, "Novel genotypes in mixed cultures of biochemical mutants of bacteria," *Cold Spring Harbor Symp. Quant. Biol.* 11, is listed as "in press"). Lederberg and Tatum shared the 1958 Nobel Prize in Physiology or Medicine with George Beadle, Lederberg receiving half "for his discoveries concerning genetic recombination and the organization of the genetic material of bacteria," Tatum and Beadle sharing the other half for their discovery that genes act by regulating definite chemical events.

127. Alexander Tomasz and Rollin D. Hotchkiss, "Regulation of the Transformability of Pneumococcal Cultures by Macromolecular Cell Products, (Reprinted from the *Proceedings of the National Academy of Sciences* 51:3, pp. 480-487, March 1964).

128. J.D. Watson, and F.H. Crick, "Molecular Study of Nucleic Acids: A Structure of Deoxyribose Nucleic Acid".; M.F.H. Wilkins, A.R. Stokes, and H.R. Wilson. "Molecular Structure of Deoxypentose Nucleic Acids;" Rosalind E. Franklin, and R.G. Gosling. "Molecular Configuration in Sodium Thymonucleate," (Reprinted from *Nature,* vol. 171, p. 737, April 25, 1953). Pp. (1),2-13(14). The three-paper offprint, printed in a single column format from the original monotype setting, from which stereotype plates were made in double columns for printing the journal. The single most important discovery in the biological sciences during the 20th century. Dibner, *Heralds of Science* (2nd edition), 200. *Grolier One Hundred* (Medicine), 99. G-M 256.3. Watson, Crick, and Wilkins shared the 1962 Nobel Prize in Physiology or Medicine for "for their discoveries concerning the molecular structure of nucleic acids and its significance for information transfer in living material".

129. J.D. Watson, and F.H. Crick, "Molecular Study of Nucleic Acids: A Structure of Deoxyribose Nucleic Acid;" M.F.H. Wilkins, A.R. Stokes, and H.R. Wilson. "Molecular Structure of Deoxypentose Nucleic Acids;" Rosalind E.Franklin, and R.G. Gosling. "Molecular Configuration in Sodium Thymonucleate," (Reprinted from *Nature,* vol. 171, p. 737, April 25, 1953). An early reprinting in double-column format (as printed in *Nature)*, stapled at the upper left margin. Reduced to 5-1/2 x 8-1/2 (with consequent reduction in type size). It is thought that this is one of the ca. 300 copies Max Delbruck distributed as required reading at the June 1953 Cold Spring Harbor Symposium on viruses, where Watson made the first public announcement of the discovery, (and indeed this one is marked in manuscript "Watson" at the upper right corner, though we don't know by whom). G-M 256.3

130. J.J. Weigle and G. Bertani, "Variations des bactériophages conditionnées par les bactéries hôtes," (Extrait des *Annales d L'Institut Pasteur*, 84, p. 175, Jan. 1953.) "Restriction enzymes were discovered as a result of research on a phenomenon in bacteriophage termed *host-controlled modification* or *phenotypic modification*....This phenomenon was discovered almost simultaneously in the early 1950s in four separate laboratories," Brock, p. 326. "Luria & Human and Bertani & Weigle independently discovered that bacterial hosts can affect the growth and phenotypic properties of their bacteriophages… This finding was quite puzzling at the time, especially since it appeared to subvert traditional Mendelian genetics. Later it was discovered that a number of different mechanisms were responsible for host-induced modification including DNA methylation, restriction modification, and glucosylation. Werner Arber, Daniel Nathans, and Ham Smith eventually shared a Nobel prize for their discoveries relating to restriction modification" John Dennehy, in *The Evilutionist Blogspot*, Aug. 5, 2008.

131. Alexander Weinstein, "Heredity and Development," (Reprinted from "Chemistry in Medicine," N.Y.: The Chemical Foundation, 1928.) The geneticist Alexander Weinstein had been a student of Thomas Hunt Morgan and E.B. Wilson.

132. M.H.F. Wilkins, W.E. Seeds, A.R. Stokes and H.R. Wilson, "Helical Structure of Crystalline Deoxypentose Nucleic Acid," (Reprinted from *Nature,* vol. 172, p. 759-762, October 24, 1953). "Wilkins discovered the double helix structure of DNA. He shared the Nobel Prize with Crick and Watson in 1962." G-M 256.4 "In the [A form of DNA] Wilkins and his colleagues observed about 120 intensity maxima, the intensities of which they estimated with a microdensitometer. They were then able to plot these in reciprocal space and compare them with the Fourier transform calculated for a model of the Watson-Crick type. There was no possibility of deriving the structure directly from the A pattern, but Fourier theory and model building could be combined in this way to check the plausibility of the structure," Olby, pp. 436-7.