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Review Of "The Least Likely Man: Marshall Nirenberg And The Discovery Of The Genetic Code" By F. H. Portugal

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National Laboratory controversy, the quest for a U.S. super collider for basic research, and the roles required of him as science advisor to President Bush. Marburger was a physicist and became Dean at the University of Southern California before coming to SBU. His personality was one of being a good listener and having patience and a willingness to find common ground with those who came to him. When I asked him to give an autobiographical talk to Honors College students, he told them that contrary what the public image of a college president is, the reality of the job is that of a city manager, the campus being like a small town with lots of needs from parking to eating on campus. He said a skilled administrator had to encourage faculty to take the lead in educational policy and not seek credit for such attainments. He said that trying to solve five crises a day was not uncommon. I can imagine how much more difficult it was for Marburger to take on the numerous controversies that this book describes.

Crease begins with an introduction to Marburger's life and career. Six chapters follow on Shoreham, the superconductor super collider, managing Brookhaven National Laboratory, advising the president and government agencies, measuring and setting priorities, and the attempt to establish a science of science policy. Crease uses excerpts from speeches given to agencies as well as seven speeches to the American Association for the Advancement of Science. Marburger felt his role was that of an advisor and not that of an activist or lobbyist for science programs and issues. Politics hampered what science could obtain (especially budgetary support) and what it could advocate (stem cell research, climate change studies). Marburger's dilemma was one of not appearing to be an advocate for science (which would make him a lobbyist in the thinking of his superiors) or an advocate of the government's political policy (which would make him a betrayer of science to concerned scientists desiring their views that they regarded as free of politics). Marburger did try to get agencies and science organizations to find objective measures of long-range effects of science policy. Is there a break-off point if science funding is given an annual increase? Are there limits to the numbers of PhDs in science that should be supported by government fellowships? Is there a way of predicting the fate of nuclear waste stored for tens of thousands of years when our knowledge of the future is based on the present? What are the economic costs of climate change in different countries and different centuries? Marburger felt these might be measured objectively by a careful study of the past. Reading about his involvement in controversial issues reminds us that the ivory tower image of the university is rarely possible when science depends on government financial support, when many projects cost one billion dollars or more, or when hundreds of investigators around the world are working on a common project. It also reminds us that advisors should give informed and unbiased advice. They are not the decisionmakers and politics can run roughshod over the ideals and good intentions of scientists. Finally, Marburger reminds us that scientists can be unaware of the unintended consequences or the political consequences of their work. Science policy is not generated by a simple formula of inputs. It competes with the priorities sorted out by Congress and the White House administration. This is an insider's view of how science policy works in the U.S. government.

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THE LEAST LIKELY MAN: MARSHALL NIRENBERG AND THE DISCOVERY OF THE GENETIC CODE.

By Franklin H. Portugal. Cambridge (Massachusetts): MIT Press. $27.95. xiv + 169 p. + 14 pl.; ill.; index. ISBN: 978-0-262-02847-9. 2015.

In 1953, James Watson and Francis Crick published their remarkable paper on the structure of DNA (*Nature* 171:737–738). This article opened the door to answering fundamental questions about how the genetic material replicated, mutated, and stored the genetic information. In the summer of 1966, the Cold Spring Harbor Laboratory of Quantitative Biology devoted their entire summer session to the problem of the genetic code. Rarely has there been a time in modern biological history when so many creative minds from so many diverse scientific disciplines focused so much energy on a single problem: how does the language of DNA (with four letters) get translated into the language of proteins (with 20 letters). Crick was one of the scientists who was focused on this problem. George Gamow was not a biologist or chemist, but with his background as a physicist and cosmologist added a unique perspective and had some brilliant ideas about the nature of the genetic code, some of which were on target and some of which were not. Using his prodigious intellect, Crick devised some ingenious ideas about how the one language was translated into another. Some of his ideas were correct, but others were not. At the end of his landmark 1961 paper on the nature of the genetic code (with Sydney Brenner, Leslie Barnett, and R. J. Watts-Tobin; *Nature* 192:1227–1232), Crick announced at a Moscow meeting on the genetic code that he was "startled" by the announcement of Marshall Nirenberg and Heinrich Matthaei that they had experimentally discovered one of the DNA code words. UUU coded for phenylalanine. This codon was not part of Crick's theoretical and brilliant, although not experimentally substantiated, solution to the genetic code.

Nirenberg and Matthaei took an experimental approach to the genetic code problem, using newly developed RNA synthesizing technology to start unraveling the actual nature of the genetic code. They made an RNA message that contained only uracil (U) and found that it coded for a polypeptide that contained only phenylalanine.

Portugal has written a remarkable, personal, and completely accessible scientific story of genius and discovery. It is a must read for all scientists. Nirenberg was not the most "likely man" because his academic credentials were perhaps more modest than others. But he was a person with a passion and a great intellect who made an enormous impact on all of modern science. Portugal is to be commended for an inspiring, touching, and insightful piece of work centered on an amazing, dedicated, modest, humble, and socially conscious scientist who was one of three very accomplished scientists who won the 1968 Nobel Prize in Physiology or Medicine (with H. Gobind Khorana and Robert W. Holley). Nirenberg passed away in 2010 at the age of 82.

Portugal worked with Nirenberg around the time of his Nobel Prize, and thus had a ringside seat at all of the events leading to this award. He writes warmly and personally (including the anti-Semitic issues) about Nirenberg and the events that led to the discovery of the genetic code. There is, of course, discussion of who really discovered the nature of the genetic code. Was it Brenner? Was it Crick? Science is often very competitive. See James Watson's controversial book, *The Double Helix: A Personal Account of the Discovery of the Structure of DNA* (1968. London (U.K.): Weidenfeld and Nicolson). One thing is certain: Nirenberg used the laboratory to figure out the first code word. Portugal's analysis makes it eminently clear that this soft-spoken and modest gentleman was the key who unlocked the code. All geneticists, indeed all biologists, should read this remarkable book and applaud Franklin Portugal for a job well done.

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THE BIOLOGY BOOK: FROM THE ORIGIN OF LIFE TO EPIGENETICS, 250 MILESTONES IN THE HISTORY OF BIOLOGY.

By Michael C. Gerald, with Gloria E. Gerald. New York: Sterling. $29.95. 528 p.; ill.; index. ISBN: 978-1-4549-1068-8. 2015.

This volume, part of the Sterling Milestones series, presents a compendium of the history of biology via 250 concise entries representing significant events in the biological sciences. The author, with a background in pharmacology, has previously written a few comprehensive pharmacology books intended for general audience consumption (including another publication in Sterling Milestones series), making him an ideal source for assembling this volume. The publication itself is a magnificent construction: hardcover, thick-stock glossy pages with stunning illustrations, and an appendix of further reading for each milestone. The physical volume would make an ideal display item or coffee-table book for a departmental office.

The entries are arranged chronologically as single-page digests of each milestone with enticing illustrations on facing pages. That the publisher chose the term "milestone" is significant as the 250 entries vary in character from natural phenomena to human discovery of natural phenomena to human innovation. Although the selection of the entries seems entirely reasonable, the lack of clarity for what constitutes a milestone creates a necessarily discordant style. As a result, readers will ponder the cohesion of a list containing a publication (Vesalius' *De humani corporis fabrica*), a field (botany), and a class of molecules (endotoxins), among others. Additionally, the chronological arrangement of the entries at times becomes problematic especially as the milestones approach present day. One would be hard-pressed to select a specific date for many selections as the process of creation, discovery, and elucidation often spans long periods of time. For example, the entry for DNA is placed in 1869. Although not all together incorrect, this oversimplification leaves ambiguous the understanding that 1869 marks the origins of human understanding of DNA, rather than the origins of the molecule itself. Neither does that date represent the many significant discoveries associated with DNA since its initial discovery. The author's intention may seem obvious and the text of the entry clarifies its title and date, but the DNA article is just one of many that represents the difficulty of trying to compartmentalize milestones in biology or any field.

Ultimately, the above-noted issues constitute only a minor criticism, which the author readily accepts and addresses in his introduction. The entries are actually well selected, well researched,