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Genius: The Life and Science of Richard Feynman

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passion and became a protest against Russian exploitation.

Despite the political revolution that evolved at least in part from the environmental movement and subsequently swept away the Soviet state, the authors offer a sober assessment of the future. They note that once in power, environmentalists have discovered obstacles of unexpected magnitude. Even under the best of circumstances, cleanup would require decades and cost trillions of rubles. (The authors note that the U.S. spent \$1.5 trillion on environmental cleanup between 1972 and 1988; a comparable Russian effort would cost at least 255 billion in 1991 rubles for pollution abatement alone.) Given the current economic plight of Russia and its sister republics, such expenditures are out of the question, and simply shutting down polluters is politically untenable during a time of rising unemployment and inflated living costs. Dramatic improvement is therefore not in sight, despite encouraging developments at the grassroots level.

What are the implications for the U.S.? In a chapter entitled "Crippled Giant," the authors discuss the impact of health and environmental problems on the military capabilities of our former adversary. By effectively cutting the conscript pool in half and weakening the morale and readiness of existing forces, those problems significantly undermined the Soviet threat; a resurgent, nationalist Russia would face similar liabilities.

Nonetheless, the massive problems portrayed here should be no cause for satisfaction, even to Russophobes. These catastrophes complicate Russia's

path to economic reform and political democracy, considerations of major import for the West. They will affect the operations and profitability of Western-financed businesses, particularly in the manufacturing and extractive sectors. Further, in today's global economy, the long-term costs of repairing the damage are likely to extend well beyond the borders of the former USSR. It is small compensation to contemplate the irony that the greatest wounds inflicted by the Soviet empire turned out to be upon its own resources and people.

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Gleick, James. *Genius: The Life and Science of Richard Feynman*. New York: Random House, 1992. 531pp. \$34.50

James Gleick has done it again. The author of the award-winning *Chaos: The Making of a New Science* has again combined expository power with his appreciation for the excitement of scientific endeavor and a sensitive understanding of the creative process, to present a thoughtful biography. This book is not just a recitation of the accomplishments of Richard Feynman and his colleagues in mathematical physics; it is a series of essays about creative genius, the nature of science and of scientific proof, and on the intersections of fundamental science and philosophy. Gleick shows the many manifestations of Feynman's genius, though he can give no "recipe" for that quality.

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There are important insights here for military technologists and for policy and executive-level individuals in the national security establishment. *Beware orthodoxy. Tolerate the unconventional approach. Revere imagination*, especially the imagination that leads to quantitative and predictive results. In many aspects of the national security world, such characteristics are in conflict with either discipline or institutional goals. Reflect on Feynman's contribution to the resolution of the causes of the *Challenger* disaster.

Richard Feynman was a major force in modern physics until his death in 1988. His intuitions and the revolutionary series of mathematical tools and formulations (such as quantum electrodynamics and path-integrals) that he developed became underpinnings for many advances in particle physics. These advances, in turn, strengthened our understanding of nature. Much of this work had its beginnings in the Manhattan Project, where it was necessary to compute such quantities as critical mass and device yields.

Feynman's life corresponded to that of physics in the latter two-thirds of the twentieth century. It happened that where Feynman was, there also was the frontier of mathematical physics. He was not the only one at the frontier. Gleick introduces the reader to the pantheon of mathematicians and physicists who provided the crucibles of intellectual criticism in which Feynman's intuitions were tested and modified: Albert Einstein, Niels Bohr, Lars Onsager, Murray Gell-Mann, Sir Frank Dyson, Edward Teller, Robert Oppenheimer, Enrico Fermi, and Paul Dirac.

The book is arranged in chapters that deal successively with Far Rockaway (early promise, chemistry sets, and amateur radio), the Massachusetts Institute of Technology (*Mens et Manue* — Mind and Hands, the importance of physical reality and of a stimulating environment), and Princeton (doctoral study, insights into creativity).

The fourth chapter is titled "Los Alamos." Feynman was the leader of the Diffusion Division, assigned to provide the theoretical understanding of isotope separation and of such things as calculation of safe limits on radioactive mass. The final two chapters, which take up nearly two hundred pages, trace Feynman's intellectual achievements, rivalries, and style at California Institute of Technology and Cornell University. The author captures something of the catalytic effects that Feynman had on his colleagues and students, and of the many faces and forms that creativity can take.

If there are passages in this book where Gleick seems to trivialize Feynman (for example, his bongo drum playing or his relationships with women), it may be because Feynman never took himself very seriously. In the larger context, Feynman's life is an argument that, though license cannot be equated with genius, one should not attempt to apply conventional standards of decorum, or morality, to creative genius. That message may be a difficult one for members of the profession of arms, for we are, by and large, a conventional lot. One can only be thankful for and appreciative of the forbearance of General Leslie Groves of the

Manhattan Project, at the dawn of the nuclear age.

Feynman was full of fascinating contradictions, which Gleick skillfully reports. For example, Feynman was in total awe of nature, and yet he was an agnostic. Although he was an acclaimed teacher, he left only a small legacy of students who studied with him directly—Feynman refused responsibility for individual graduate training, as a condition of his employment. He published reluctantly and did not write about all that he had accomplished. But this was consistent behavior for Feynman. What he treasured most was innovation; he did not regard mere efficiency to obtain known results as a contribution. He detested the formal subject of philosophy, and yet he cleared new paths in the rigorous application of the scientific method.

Gleick shares with us a statement of the great mathematician, Mark Kac. Kac identified two kinds of genius, the ordinary and the magician. The ordinary kind represents attainment and skills that we could all reach if we were ten times better than we are; there are no real mysteries as to methods or processes. But the magician is different. The mind of the magician is incomprehensible and its processes remain hidden, even as we gain understanding of what they have done. Seldom, if ever, do magicians have students, because they cannot be emulated. Richard Feynman, concludes Gleick, “was a magician of the highest caliber.” Of himself Richard Feynman said, “I was born not knowing and have only had a little time to change that here and there.”

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Sturgill, Claude C. *Low-Intensity Conflict in American History*. Westport, Conn.: Greenwood, 1993. 160pp. \$49.95

Claude Sturgill has published the professor's dream, a student syllabus at a nifty price. The rest of us need not bother purchasing, reading, or even looking through this offering. A book this work is not—nor is it, as the title would imply, a history. Its utility can only be judged in a classroom, where, one hopes, Sturgill will provide the rest of the story.

The author's stated purpose is to “organize this ponderous amount of worthwhile news [for] the average person. . . .” To accomplish that, Sturgill applies a checklist, “as a quick method of analyzing where the march of current events is leading,” up to the start of a “real war.” To assist the reader, he provides a list of nearly every conceivable variation on the term “low-intensity conflict”—fifty in all—and then abruptly produces an eighteen-point checklist, obviously for classroom use.

From that point on, the book meanders haphazardly downhill, drawing primarily on information gained during the author's aperiodic contact with both special operations forces and military educational institutions. The first four chapters include discussions on Mexico, the Philippines, El Salvador, Afghanistan, Nicaragua, Son Tay, Ko Tang, and Iran, with a side trip into terrorism and