POSTERMINARIES

Leadership Material

Ioseb Vissarionovich Dzhugashvili started it, just over a century ago. The son of a poor cobbler in a provincial backwater, his academic career ended with expulsion from a theological seminary. Undeterred, he recognized that his ambitions would be well served if his persona reflected one of the prominent measures of national prowess, so he moved to the center of power and changed his name to Joseph Stalin; borrowing from the Russian "stal," or "steel."

For much of the 20th century, it was the production or control of materials that most critically defined the extent of national power. As the century dawned, steel output was the most important measure. At later times, access to "critical materials," such as chromium, has been a matter over which wars have been fought, or at least it has determined the strategies of one or another party in the major wars. During the Cold War, one of the most important numbers sought by spies on either side was the uranium demand of their respective opponents, since that was the most direct measure of the number of atomic bombs that they planned to build. But times change: What critical material must we control now to assure national security? Materials science, like dentistry, has its own success to blame for making its original role obsolete: For us, our loss in the arena of realpolitik comes because no material is as critical as steel, chromium, rubber, or molybdenum once were. Now we have an almost wonderful ability to substitute for materials once used uniquely, as well as such sophisticated though lifeless measures of power as Gross National Product instead of steel production. Ask any teenager the meaning of "gross."

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But the history of the 20th century *was* largely determined by national needs for materials, so you might expect to find some materials scientists prominent among the world leaders of the time, right? It's a pretty sorry history if you have any pride in your discipline. Herbert Hoover was a member of the Mining and Metallurgy Society of America, a fore-runner of AIME, before he became president of the United States of America. He was a scholar and a gentleman, widely traveled, and broadly enough educated to translate (with the help of his wife) the earliest known

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metallurgical textbook, Agricola's *De Re Metallica* from its original Latin. (You can still obtain a copy of Hoover's translation, with facsimiles of the original figures, from Dover Publications in New York.) For all his learning and prominence in the field of metallurgy, though, Hoover was not one of the most distinguished residents of the White House. He is remembered mostly for leading the U.S. into the great depression and selfishly insisting upon affixing his own name to the greatest public-works project of his time, a dam on the Colorado River.

Leonid Brezhnev was not born into such a privileged life as Hoover, but he was the Soviet leader from 1964 to 1972. One of six workers' children among 45 students in his school, he liked math best, but only did average work, generally speaking, and notably poorly in foreign languages. One of his earliest jobs was as a laborer in a steelworks, and through part-time schooling he eventually graduated from the Arsenich Metallurgical Institute in Dneprodzerzhinsk, after presenting a thesis on "The Design of Electrostatic Cleaning of Furnace Gas in the F.E. Dzerzhinsk Factory." Take note, please, of the industrial bent of his research topic, and his determination and quite striking ability to overcome a lackluster academic record: He eventually served as director of the Dneproderzhinsk Metallurgical Technical College. Academic politics must have prepared him well for his time in the Kremlin. Or maybe *vice versa*.

Aleksei Nikolaievich Kosygin, who shared power with Brezhnev in the complicated Communist Party hierarchy, studied at the Leningrad Textile Institute in 1930. He would not have been recognized as a materials scientist at the time, and all of us have probably suffered from the problem of being mistaken for some kind of textile engineer when we have announced our profession at a cocktail party. These days, though, textile engineering is moving in from the fringe of materials science to the center of some of its activities, notably in the area of fiber-reinforced composites, so perhaps we can consider Kosygin to have been a man ahead of his time, and include him in the minuscule panoply of world leaders who have started out as materials scientists.

Jimmy Carter, the 39th president of the United States, would never have claimed to be a materials scientist, but occasionally tried to belie his characterization as a simple peanut farmer by claiming the title of "nuclear engineer," based upon his service in the U.S. Navy. Since MRS has a long-running tradition of technical programming in the area of nuclear waste management, maybe we can stretch a point and include Mr. Carter as an adjunct materials scientist, in the interest of boosting our numbers on the world stage. Sadly, his was not a very distinguished presidency, either, ending in disarray with American embassy staff held hostage in Tehran, so it does little to redeem the reputation of our subject on the world stage. On the positive side, however, like many U.S. presidents after Hoover, Carter is better regarded in retirement than he ever was in office, so perhaps this is a group we should try to identify with a little more. Margaret Thatcher, the one-time "iron lady" of British politics, arguably has real credentials in materials, beyond her nickname, having worked as an industrial research chemist, once publishing a paper on Langmuir–Blodgett films. Named in her honor, too, is a professorship in the Department of Materials and Interfaces at the Weizmann Institute of Science in Israel. It is not clear whether all of this actually justified the Royal Society in bestowing a fellowship upon her "for services to British science," but at least she stands as an undeniable example of strong leadership.

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Let's face facts. If we are trying to portray the study of materials as a means of preparation for a life of political leadership, we have precious few examples to point to, and most of those are not all that attractive. This is despite the fact that our work teaches us to compromise over conflicting demands (for properties), and even to create coalitions (or composites, in our case) that bring together the best properties of disparate factions (or materials). I don't see any cure in sight: The researcher "scholar and gentleman," once personified by Hoover, has long since been supplanted as the predominant persona among materials scientists by the "geek." Just look around your lab and you will see what I mean. Can you imagine any of your colleagues having any real political appeal in an election campaign? I think we should not expect to find too many grassroots MRS members getting elected to high office anywhere in the world very soon.

However, the real power in a complex modern state lies not so much with the figurehead as with the people who surround and advise him or her. MRS Von Hippel Award recipient Sir Alan Cottrell has filled the role of chief scientific advisor to the British government with some distinction. Donald Evans now serves as Secretary of Commerce in the Washington administration of George Bush the Second: not so much a leader as a technician within the government. Evans is business-trained, like his leader, but also holds a degree in mechanical engineering and has, like Brezhnev, worked in a steel mill, which must count for something. Another Bush cabinet member is Treasury Secretary Paul O'Neill, who was chair and CEO of Alcoa from 1987 to 1999, and retired as chair at the end of 2000, just in time to join the new administration. Prior to joining Alcoa, O'Neill was president of the International Paper Company from 1985 to 1987, where he was also a vice president from 1977 to 1985. He may only be a businessman with degrees in economics and public administration, but his success at making money out of materials has been used as a case study by the Harvard Business School.

So it appears inevitable that for the next generation or so, at least, materials professionals will wield power not through elected office, but through appointment to advisory roles in the world's governments. And what is the record of success in this role? Only one critical review stands out. U.S. Senator Edmund Muskie wished for a one-armed scientist to advise him, who would not qualify his advice with "on the other hand...." So those of you who would go into this strange form of leadership take heed: Political decisions are made out of single recommendations, not lists of options. Give your elected officials a clear message, and don't confuse them with counter-arguments or alternatives. If they were bright enough to distinguish between all of the options, they would be scientists, not politicians, after all, or at least they wouldn't need you to advise them. It was Ralph Waldo Emerson who noted the little-mindedness of politicians, long before the 20th century dawned, and observed how their thinking was hobbled with the need for "foolish consistency." The influence of materials on the world stage may have come and gone, but the character of the politician remains the same.

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