Hail to the Chief (Chemist) who's the leader of other nations

In an earlier essay I had explored the question about members of the United States Congress that had been trained as chemists. At the time of this writing, the party conventions are over and the presidential election campaigns for 2012 are just beginning to ramp up. It seems like a good time to ask which heads of state were trained as scientists or engineers.

The names of two chemists that immediately come to mind are Margaret Thatcher, who served as Prime Minister of Great Britain between 1979 and 1990, and Angela Merkel PhD, the first female Chancellor of Germany who was elected to that position in 2005.

Alas, we have never had a chemist in the White House but we have had two engineers, one med school drop out, an astronomy buff, a lawyer who was known to have tinkered with steam boats, and one universal genius.

In researching this essay it became clear that scientists and engineers who have entered politics are still comparatively rare and many of those who did enter the field remained essentially outsiders in a world dominated by lawyers and business people. The two presidential candidates in the 2012 election are classic insiders although both would vehemently deny this. Mitt Romney attended Harvard Law School and Harvard Business School. He received both a law degree and a Master of Business Administration degree in 1975 before going on to found Bain Capital. He lead the Salt Lake Organizing Committee for the 2002 Winter Olympics and was elected Governor of Massachusetts in 2002. Barrack Obama graduated magna cum laude from Harvard Law School in 1991. He practiced as a civil rights lawyer, taught at the University of Chicago Law School, and helped organize voter registration drives. He ran for the Illinois State Senate as a Democrat and won election in 1996.

The Presidential Polymath, Thomas Jefferson (1743 – 1826)
President from 1801 to 1809

The third president of the United States, Thomas Jefferson, lived at a time when there were few scientists in the modern sense. There were a few full-time astronomers, a handful of university professors of chemistry or geology but many of these were also physicians or clergymen. There were no full-time agronomists, biologists, or physicists but a great many amateurs working diligently in those fields. Thomas Jefferson trained as a lawyer, preferred to think of himself as a farmer, and is today regarded as a true polymath. Jefferson was a native of Virginia and the son of a planter. He attended the College of William and Mary, then practiced law and served in local government. In 1776 while serving a representative of Virginia to the Continental Congress, he was selected to draft the Declaration of Independence. Between leaving the Continental Congress and being elected president in 1800, Jefferson served as Virginia's governor from 1779 to 1781, he was also minister to France, and this was followed by an appointment to serve as Secretary of State under President George Washington.

Jefferson made many important contributions to science in the early days of the United States. While minister to France he collected books, scientific instruments, seeds, and other specimens that were sent back to the United States. Jefferson later sold his collection of books to the government and they made up the nucleus of the Library of Congress. At age 76, he helped establish the University of Virginia. Not only was he the political organizer behind the university's founding, he designed the buildings, planned its curriculum, oversaw faculty recruitment, and served as the university's first rector.

Jefferson the scientist emerged during the American Revolution. While working full-time in politics, Jefferson became a part-time geographer. France had recently entered the American Revolution against Great Britain and began systematically collecting data about its new ally. A series of questionnaires were sent to various state governments. France's government wanted to know about population, climate, natural resources, agricultural production, political systems, and physical geography. Jefferson answered the questionnaire for the state of Virginia and his notes on the subjects were later expanded into his most important scientific book, *Notes on the State of Virginia*.

Jefferson's writings about North American mammals published in *Notes on the State of Virginia* addressed one of the most important zoological questions of the period, just what were, American mammals? During the first half of the 1700s only a few white Europeans had any real experience of north American animals. A number of noted zoologists hypothesized that the animals of the new world were simply "degenerate" forms of old world species.

Jefferson was ideally placed to refute this idea. At the time the first Mastodon skeletons were being discovered in bogs and lake beds. These large animals had been extinct since the last ice age but were never the less definitive proof that north America did indeed have *big* animals. Jefferson collected Mastodon bones and corresponded with leading scientists about the latest fossil discoveries.

In addition to his interests in botany, ethnography, geology, fossils, and zoology, Jefferson was also capable of reading and writing Greek, Latin, French, Spanish and Italian. He had also enough mathematical ability to calculate the timing of an eclipse in 1788 as well as making suggestions about revising almanacs using more accurate astronomical calculations.

Jefferson was elected to the American Philosophical Society in 1780 and served on many of its committees. He would later be elected president of the society and would hold that office for eighteen years. In 1797 he was a member of the Antiquarian committee (or the more descriptive "Bone" committee). In 1807, Jefferson financed William Clark to excavate a Mammoth skeleton at Big Bone Lick, Kentucky. The excavation recovered more than 300 bones which Jefferson then offered to the society.

Jefferson was also the chairman of a committee that studied the Hessian fly. *Mayetiola destructor* is one of the most serious threats to wheat. It is believed to have originated in the southern Caucasus region of Russia. The name comes from the Hessian mercenaries employed by the British during the American Revolution. The fly appears to have been brought to this country in the straw bedding used by the troops.

Jefferson also used his position in the American Philosophical Society to encourage the exploration of the western states. When sending out the Lewis and Clark expedition of 1804 to 1806, he turned to the society's members for advice on botany, ethnography, medicine, zoology, mathematics, and astronomy. When the Lewis and Clark expedition returned, the society became the repository for many of its specimens and the official expedition journals.

Perhaps the greatest tribute to Jefferson's contributions to science came from President John F. Kennedy. In hosting a White House dinner for a group of Nobel Laureates, he remarked that such a collection of brainpower had not been gathered for a White House dinner since, "Thomas Jefferson dined alone."

American Science Looks Up, John Quincy Adams and Astronomy. (1767 – 1848) President from 1825 to 1829

John Quincy Adams was the son of John Adams, the second president of the United States. John Quincy was born in 1767 and when only tens years old, accompanied his father to Europe. During the American Revolution John Adams represented the Continental Congress in the courts of Paris, Amsterdam, and St. Petersburg. John Quincy mastered several European languages and grew to maturity in the diplomatic service. After serving in a number of diplomatic posts, including assistant to his father in the negotiations that ended the American Revolution, he returned home to complete his law degree at Harvard.

President George Washington appointed John Quincy minister to The Netherlands and this was followed by an appointment as minister to Prussia. He returned home and was elected to the Massachusetts legislature. He later served in the United States Senate. But further diplomatic appointments took him back to Europe. He was the first U.S. minister to Russia and then served as a member of the delegation that negotiated the treaty ending the War of 1812. His last posting was to the English court for two years.

Adams was elected President in 1824 but lost his reelection bid to Andrew Jackson. He was soon back in Washington having been elected to Congress from his home state of Massachusetts in 1830. It was during this time that he made his greatest contribution to American science.

James Smithson was a wealthy Englishman who had the misfortune to be the illegitimate son of the Duke of Northumberland. He graduated from Oxford in 1786 and quickly became a recognized leader in the fields of chemistry and mineralogy. He was elected to the Royal Society in 1787 and published a number of papers before his death in 1829. His will was somewhat curious, he left everything to his nephew, Henry James Hungerford. If however the nephew died without an heir, the money would be given "to the United States of America, to found at Washington, under the name of the Smithsonian

Institution, an establishment for the increase and diffusion of knowledge ...." Despite his very aristocratic birth, Smithson made it a point never to use his family connections to advance his scientific career. Perhaps he felt that science in the more democratic United States was more of a meritocracy. Perhaps he felt that his money would help unlock the mineral and geological resources of the new nation. Perhaps as the illegitimate son of a Duke, he would never get his name on any British institution. Whatever the reason, Henry James Hungerford died childless and the United States Congress soon found itself holding $515,000 in gold with only some vague instructions about how to spend it.

Congressman John Quincy Adams soon emerged as the conscience of the Congress and made it his mission to see that the money was spent wisely. As might be imagined, there were a number of proposals. One senator from Rhode Island proposed a national university, with himself as president. Others believed that the bequest should be used to create a national library. Adams and others noted that libraries were excellent ways to increase the diffusion of knowledge, but not very helpful for increasing it. Princeton University Professor Joseph Henry made several crucial discoveries in the field of electromagnetism and his contributions to the invention of the telegraph made Henry the most respected scientist in America. Henry argued that only a research institution could increase knowledge by making new discoveries, and that he, Joseph Henry, should be the one who made the discoveries. (Henry later served as Secretary of the Smithsonian.) Other members of Congress called for the establishment of a teacher training college with an experimental farm and a few chemistry laboratories. However an institution that focused on education would not have time for the increase of knowledge among the larger society. It was perhaps the first time in American history when the distinction was made between a college devoted to teaching and an institution devoted to research.

Adams advocated looking skyward, he believed that the money should be spent on an observatory. Although astronomy had practical applications in celestial navigation, creating tide tables, and creating calendars, Americans generally regarded it as too theoretical. Having a world-class observatory however would create interest in the sciences and encourage American astronomers. He spoke passionately on the subject of a national observatory on a number of occasions. The US Naval observatory was founded during the Smithsonian debate and Adams seems to have been content that the need for such an institution was satisfied. However he did not relinquish his role as the conscience of the Smithsonian bequest.

Adams and his allies in congress noted that the original bequest did not limit the new institution to any one branch of knowledge. Adams was instrumental in assuring that the Smithsonian was founded not as a library, or teachers college, or even as an observatory, it would become an institution devoted to all branches of knowledge. Sadly, Adams died of a stroke just as the Smithsonian Institution was being established.

Work on The Castle, the oldest building of the Smithsonian began in 1847. The Castle's architect, James Renwick, Jr., would later design Saint Patrick's Cathedral in New York City.

Today the Smithsonian is one of the world's premier museums and research institutions. It has grown into a system of 19 museums, 9 research centers, and more than 140 affiliate museums around the world.

Med School Drop Out, William Henry Harrison (1773 – 1841)
President from January 1841 to April 1841

Harrison was born into the Virginia slave-holder aristocracy. He studied classics and history at Hampden-Sydney College, then switched to the study of medicine in Richmond. Then in 1791 he discontinued his medical studies and sought a commission with the First Infantry of the Regular Army.

Harrison served in what was then known as the Old Northwest, the states of Ohio, Michigan, and Illinois. After several campaigns against the Indians he became Secretary of the Northwest Territory and was its first delegate to Congress.

He was elected president in 1840 but in one of history's great ironies, the one-time medical student insisted on remaining in the cold rain that fell during his inauguration ceremony. He caught a cold, it turned to pneumonia, and within four months William Henry Harrison became the first president to die while in office. He also holds the record for the shortest term in office.

Holder of US Patent Number 6,469, Abraham Lincoln (1809 – 1865)
President from 1861 to 1865.

The 16th president, Abraham Lincoln remains the only president to have a patent in his name. As a young lawyer and rising politician in Illinois, Lincoln was keenly interested in the nation's transportation infrastructure, turnpikes, steamboats, canals, and railroads. He made numerous speeches promoting what were then referred to as internal improvements and would later count the Illinois Central Railroad as one of his law clients.

Lincoln was also fascinated by machinery and things mechanical so it is not surprising that he would turn his attention to the problems that steamboats encountered on the inland rivers. One of these was getting stuck on the constantly shifting sandbars. In 1848 Lincoln was a passenger aboard a steamboat that stuck on a sandbar. He watched the crew shove planks and force empty barrels under the hull until the boat became buoyant enough to float off the sandbar.

US Patent number 6,469 was granted on May 22, 1849. It describes a mechanism for "Buoying Vessels Over Shoals" that consisted of huge bellows made of "india-rubber cloth, or other suitable water-proof fabric." When deflated, these bellows would ride on outriggers positioned very close to the main hull of the steamboat. If the boat became stuck, they would be inflated and pushed under the hull with long poles.

Like all inventors in that time period, Lincoln was obliged to submit a model to the Patent Office along with his paperwork. The model survives and is now in the collection of the Smithsonian Institution.

Mining Engineer, Scholar, and Humanitarian, Herbert Hoover. (1864-1974) President from 1929 to 1931

Hoover was born in Iowa, the son of a Quaker blacksmith. After the death of both parents, he was adopted by an uncle in Oregon where he grew up. In 1891 he entered newly established Stanford University as a member of its first freshman class. He graduated in 1895 with a degree in geology.

While in Stamford, Hoover worked in the office of Professor John Casper Branner, his mentor in the geology department. He also ran a laundry service, had a newspaper route, and spent his summers doing field work with the United States Geological Survey. In a foreshadowing of his future career as an administrator, the was elected treasurer of the junior class, and he managed both the football and baseball teams.

After graduation Hoover worked at a number of mines in California, New Mexico, and Colorado. Fortunately for him, his new bride Lou Henry was also a geologist who enjoyed the outdoors as much as he did. While traveling and working in mining areas around the globe, Herbert and Lou Henry began the monumental task of translating *De Re Metallica* (On Metals) from Latin to English.

De Re Metallica was written entirely in Latin by Georg Bauer (1494-1555) under the pen name of Georgius Agricola. Published a year after his death, *De Re Metallica* was the first scientific book in the west to discuss mining and metallurgy. There are more than 600 pages the text that are illustrated with over 200 woodcuts. Bauer wrote only about those things with which he had personal experience or observation. He covered stratigraphy, occupational diseases of miners, assay techniques, ore processing, and smelting. *De Re Metallica* would be the standard work on mining for the next 200 years.

After Lou Henry saw a copy in a London bookshop, she rather innocently inquired if an English translation was available. No, if the Hoovers wanted one, they would have to do that themselves. Between 1907 and 1912 the Hoovers spent almost all of their spare time working on the translation. They did receive help from other scholars who could translate Latin. Bauer however had to translate 16^{th} century mining terminology into Latin, and the Hoovers relied on Herbert's specialized knowledge to translate them correctly into modern English. While living in distant mining camps they even conducted experiments to replicate the assay techniques and converted the unstandardized medieval measurements into modern units.

The Hoovers' translation of *De Re Metallica* was first published in 1912 and remains a classic text in the history of science. Almost every president has written at least one book, Jimmy Carter has written 27, but Hoover remains the only president to have produced an enduring piece of scholarship.

The First World War broke out in 1914 and Hoover was appointed head of the Food Administration. His job was to cut domestic food consumption so that food supplies could be sent overseas to the war zones. In this he was successful and after the war, Hoover was involved in the American Relief Administration. The Relief Administration shipped millions of tons of food to central Europe and a famine-stricken Soviet Russia. Hoover's success in these efforts made him one of the world's leading humanitarians and lead to his appointment as Secretary of Commerce. He received the Republican nomination for president in the 1928 election.

History remembers Hoover as a not particularly effective president during the onset of the Great Depression and many people deride Hoover's attempts to cope with the crisis as being half-hearted and too reliant on market forces. Hoover had the great misfortune to be elected in 1928 when the national economy was still strong. The stock market crash of 1929 shook the economy to its core but was a only one of the triggers of the Great Depression, not its cause.

The causes of the depression are many and are still keenly debated by economists. However the human toll was severe and the worst years coincided with Hoover's presidency. By 1932, unemployment was between 25 and 30% and industrial production had fallen 54% from its 1929 levels. At the start of the depression, there were the 25,000 banks in the United States and by 1933, 11,000 had failed. Hoover's response was that of an engineer, he saw a problem and proposed solutions.

Many of the most successful depression-era New Deal programs originated with Hoover's presidency. These included the Agricultural Adjustment Act, the Reconstruction Finance Corporation, and the Federal Emergency Relief Administration. Although a conservative, Hoover freely called for government regulations where he saw the need for them. He would also call for voluntary responsibility and individual initiative where he saw those as appropriate.

According the book *Herbert Hoover: A Public Life*, it was the engineering ethos and a related political naïveté that were at the core of Hoover's political failures. His engineering background taught him how to find solutions to very complex problems but left him unprepared for selling them to a skeptical public or a recalcitrant congress. He was never able to construct a grand synthesis of his competing ideas and then articulate it as the basis for clear policy.

For more information see: Hannaway, O., Herbert Hoover and Georgius Agricola: The. Distorting Mirror of History, *Bulletin of the History of Chemistry*, 12: 3-10, 1992

The Nuclear Engineer, Jimmy Carter. (1924 -)
President from 1977 to 1981.

James Earl Carter, or "Jimmy" Carter served as President from 1977 to 1981. He was born in Plains, Georgia in 1924. After graduating from public school, he entered Georgia

Southwestern College and the Georgia Institute of Technology. With the Second World War raging, the transferred to the US Naval academy at Annapolis. Like many wartime graduates, Carter did not have a formal major at the Naval academy. He was enrolled in an accelerated program that included mathematics, engineering, navigation, and seamanship. He was awarded a bachelor of science degree in 1946 and after two years on surface ships, entered the submarine service in 1948.

Carter's career as a nuclear engineer began when he was selected by Admiral (then Captain) Hyman Rickover for the Navy's fledgling nuclear submarine program. In 1952 he was sent to the Atomic Energy Commission's Division of Reactor Development which was located at Union College in Schenectady, New York. Carter began graduate work in reactor technology and nuclear physics. He was not however, an ordinary graduate student.

At the time the US Navy was building its second nuclear submarine, the *USS Seawolf*. Carter's formal classes lasted only one semester and his principle responsibility was to train both himself and the future crew of the *Seawolf* in the operation of the submarine's reactors. Like many graduate students, Carter taught classes but his pupils were members of the *Seawolf's* crew, not undergraduates. These classes included mathematics, physics, and reactor technology. The Navy officers assigned to the Division of Reactor Development were expected to take a hands-on role in reactor development as well as qualifying themselves to operate the reactors as engineering officers while at sea.

The *USS Seawolf* was built with a reactor that was cooled with liquid sodium. It was fueled with uranium dioxide (uranium (IV) oxide) clad in stainless steel with beryllium serving a moderator and reflector. Liquid sodium cooled reactors have higher operating temperatures (about 1,700 f or 927 c) and greater thermal efficiency than water-cooled reactors. But they also had serious drawbacks. The sodium tends to become radioactive when exposed to the nuclear fuel. Although the half life on the sodium is only about 15 hours this does make additional shielding necessary. Sodium will also ignite on contact with air or water so the *Seawolf* class submarines had to have the reactors housed in special compartments that would contain a sodium fire. The sodium cooled reactors were removed from the *Seawolf* in 1959 when the decision was made to standardize the fleet on pressured water reactors.

Carter was also a member of a team that helped decommission a civilian nuclear power plant at Chalk River, Canada. The plant had gone out of control and suffered a melt down. The reactor core was so radioactive that a person could only spend about 90 seconds working on it. The team created a mock-up of the damaged reactor and divided the decommissioning tasks into 90-second blocks. They practiced the task on the mock-up and then were suited up for descent into the contaminated area. They worked frantically until it was time to be pulled back out.

Carter was awarded a graduate degree from Union College but he was forced to leave active duty with the Navy when his father died in 1953. He returned home to Georgia to help manage the family interests. When not active in politics, he was a peanut farmer in his hometown of Plains, Georgia. Carter was elected governor of Georgia in 1970 and won the presidential election of 1976.

Carter was elected president at a time that the nation was reeling from its loss in the Vietnam War and the Watergate scandal that had forced President Richard Nixon to resign from office. His engineering background and governorship of Georgia made him appear an attractive outsider after the scandals of the Nixon Presidency. However the economy was in a severe recession with interest rates and inflation both at high levels. Unemployment was up and hope was down. There were also serious problems in foreign affairs. In 1979 the American embassy in Tehran was taken over by militants following the Iranian Revolution and the embassy staff was held hostage for 444 days. In 1980 the Soviet Union invaded Afghanistan creating another crisis for an increasingly beleaguered administration.

Carter's response to all of these problems was, like Hoover's, that of a highly intelligent engineer. He saw problems and proposed solutions but to many people his leadership seemed to lack passion. Passionless leadership can be tolerated but to many observers Carter's real weakness seemed to be an inability to prioritize his goals. When operating a nuclear reactor, every detail is important and as long any one item is on the engineer's checklist, it gets done. Politics does not work that way.

Critics claim that he had an engineer's faith in organizational efficiency but lacked the politician's ability to construct a simple, unified narrative describing what needed to be done.

Carter did have a number of significant foreign policy accomplishments. The Camp David Accords (1978) was a treaty of peace between Egypt and Israel. The SALT II arms limitation treaty with the Soviet Union was signed in 1979. His administration was the first to establish diplomatic relations with the People's Republic of China. Carter's championing of human rights throughout the world is credited with helping create the conditions that eventually lead to the collapse of communism in the Soviet Union and eastern Europe. For the Camp David Accords and his commitment ho human rights, Carter was be awarded the Nobel Prize in 2002.

For more information: Carter as Scientist or Engineer: What Are His Credentials? *Science* 6 August 1976: 462-463.

The Conservative Outsider, Margaret Thatcher (1925 -)
Prime Minister of Great Britain 1979 to 1990

In the 1950s when Thatcher first entered politics, she was an outsider in a number of ways. She grew up as the daughter of a grocer in a provincial Lincolnshire town. Most Conservatives were denizens of London. Thatcher was the daughter of a middle class parents, while most leading conservatives were wealthy, or at least upper middle class. There were no women among the party leadership, indeed the demographics of the Conservative Party leadership had scarcely changed since the 1800s. Thatcher never served in the armed forces, never traveled outside of England, and in a group made up entirely of graduates in the arts and literature, Thatcher had been trained as a chemist.

As a student in the local grammar school, Margaret focused on biology, chemistry, and mathematics during her sixth form (after age 16). Her decision seemed to have been influenced by a variety of factors, science appealed to a practical-minded young woman, the employment prospects were very good, and she had the influence of her school's excellent chemistry teacher.

She arrived at Oxford's Somerville College in 1943. At the time chemistry was Oxford's largest undergraduate school and its students had the benefits of new laboratory facilities constructed in 1941. Thatcher did not particularly impress her first faculty mentor, Dame Janet Vaughan, who described her as being a "perfectly adequate chemist." However Thatcher's biographers point out that Vaughan was more left-leaning and would have found herself at odds with any student who was a member of the Oxford University Conservative Association. Thatcher's second faculty mentor was Dorothy Hodgkin. Hodgkin was an X-ray crystallographer who was noted for her work on the structure of penicillin and related drugs. During Thatcher's senior year Hodgkin had obtained samples of *gramicidin S*, a potent antibiotic compound first identified by Russian chemists. An investigation of the compound's structure became the topic of Thatcher's undergraduate research. Dorothy Hodgkin would later be awarded the Nobel Prize in chemistry in 1964 "for her determinations by X-ray techniques of the structures of important biochemical substances."

In 1947 the young graduate was selected for an administrative post with British Xylonite Plastics but this did not materialize and Thatcher "found myself donning the white coat again." She worked on projects related to binding polyvinyl chloride to metal substrates.

Thatcher had remained active in conservative politics throughout her undergraduate days and in 1949 was selected as the Parliamentary candidate for the constituency of Dartford. Unfortunately Dartford was too far from the British Xylonite plant for her to be a chemist by day and campaigner at night. She obtained a more convenient position as a food chemistry researcher at J. Lyons and Company in London. There she worked testing the quality of pie fillings, cake fillings, and ice cream. This fact has often lead to a much-repeated tale that Thatcher was a member of the team than developed soft-serve ice cream. J. Lyons did develop soft-serve ice cream at the time, but there is no evidence that Thatcher was active in that project. She did perform original research on saponification.

Thatcher never actively used her scientific background to promote herself as a politician although she was photographed wearing a white lab coat and working at a laboratory bench for her 1951 election campaign. That year, Thatcher married her husband Dennis and left chemistry to study law. Most chemists who made this career change went into patent law but Thatcher felt that tax law was a better field for an aspiring politician. She was admitted to the bar in 1953. In 1959, she entered Parliament as a member of the Conservative Party representing Finchley, in North London.

In 1970 she was appointed Secretary of State of Education and Science by Prime Minister Edward Heath. Within a year, a former industrial chemist with fewer than five years experience at the bench would find herself at the very center of a debate over Great Britain's entire approach to science policy.

At the time, there was a minor debate in the government over the organization of government sponsored agricultural research. The ARC or Agricultural Research Council was responsible for basic research into agronomy and the various experimental farms operated by the Ministry of Agriculture worked on the applied research. The problem faced by the government was to find better ways of integrating the two types of research. The issues surrounding the ARC and the experimental farms were only the most visible manifestation of a deeper problem concerning the ways that basic and applied research were, and were not, being integrated by British scientists. Meanwhile, Lord Rothschild was leading a special government commission studying the ways and means by which Great Britain organized scientific research. Although born into a very wealthy family Rothschild, like Smithson, tried to advance solely by his considerable scientific talents and not his family connections. He was appointed a fellow at King's College on the strength of his work with frog eggs, worked during the Second World War as a bomb disposal expert, and later served as the Director of UK Research for Royal Dutch Shell.

Rothschild released his commission's report in 1971. It called for sweeping changes in the way research was viewed by the government. In his view, researchers were essentially providing a "service" to "customers." The customers could be government agencies or industrial concerns but the essential model was that there would be an open marketplace for research services and that any institution was free to compete within it. Not surprisingly the Royal Society, comprised of Britain's leading scientists, had other ideas. In their view, any change to the way that research was structured would require their "consultation." While they did not use the word, what they really meant was that changes should not occur without their consent.

At first Thatcher was content merely to convey the concerns of the Royal Society to her cabinet colleagues and the Prime Minister. She also expressed concerns that the changes called for in Rothschild's report would compromise Britain's ability to do basic research. But Heath's government wanted market-based reforms and the Secretary of State of Education and Science would have to decide if she was going to support them. It has never been entirely clear if Thatcher eventually endorsed the report because it conformed with her conservative principles or if she had to be convinced by more senior members of the cabinet. It is certain that having experienced scientific work first hand, Thatcher was not awed by visions of pure research occurring ivory towers. She knew that good research could be done at universities, by governments, or by industry. A market-based model became the basis of the government's science policy.

The next major scientific issue with which Thatcher was identified came in the 1980s when climatologists first began warning of the dangers associated with anthropogenic greenhouse gasses and chemists discovered that chlorofluorocarbons were damaging the ozone layer. Thatcher played a major role in negotiating the Montreal Protocols that eliminated the production and use of these materials. Thatcher would later regard the Montreal Protocols as a model for the reduction of greenhouse gasses. After Thatcher made a speech about global warming, Sir Crispin Tickell, who was British Ambassador to the United Nations, remembered Thatcher's training as a scientist and gave her a paper about the chemistry of greenhouse gasses in the upper atmosphere. This incident helped formulate Thatcher's approach to climate change. She was, alone among western heads of state, convinced that the accumulation of anthropogenic greenhouse gasses was a threat to human survival. She was also among the first heads of state to call for their reduction.

In November of 1989 Thatcher made a speech to the United Nations General Assembly. In it she differentiated between natural climate variations and human-caused climate changes. She spoke about the increase in carbon dioxide and the loss of tropical forests, but also how fluorocarbons had been phased out once the damage they could do to the ozone layer was discovered. Thatcher cited the latest scientific observations from the Polar Institute in Cambridge and The British Antarctic Survey. She also cited the studies conducted by the British Meteorological Office on the possible effects of depleting the Amazon rainforests.

Thatcher said that "…It is no good squabbling over who is responsible or who should pay. Whole areas of our planet could be subject to drought and starvation if the pattern of rains and monsoons were to change as a result of the destruction of forests and the accumulation of greenhouse gases.

We have to look forward not backward and we shall only succeed in dealing with the problems through a vast international, co-operative effort.

Before we act, we need the best possible scientific assessment: otherwise we risk making matters worse. We must use science to cast a light ahead, so that we can move step by step in the right direction…"

Thatcher reminded her listener that a World Conference on Environment and Development would meet in 1992 and called for greenhouse gas reduction targets to be negotiated at the conference. She concluded by saying:

"…I began with Charles Darwin and his work on the theory of evolution and the origin of species. Darwin's voyages were among the high-points of scientific discovery. They were undertaken at a time when men and women felt growing confidence that we could not only understand the natural world but we could master it, too…Today, we have learned rather more humility and respect for the balance of nature. But another of the beliefs of Darwin's era should help to see us through—the belief in reason and the scientific method…Reason is humanity's special gift. It allows us to understand the structure of the nucleus. It enables us to explore the heavens. It helps us to conquer disease. Now we must use our reason to find a way in which we can live with nature, and not dominate nature..."

However like a scientist she sounded, her actions were not without some political motivations. During the 1980s a series of coal strikes were threatening Britain's economy and casting doubt on the ability of the government to deal with the more militant industrial unions. Calling for a reduction in carbon dioxide emissions would not only save the planet, it would help reduce the power of the miners' unions.

Hugo Young, author of *One of Us: a Biography of Margaret Thatcher* would ask Dorothy Hodgkin about her former student:

"…The blueprint of a practical mind, the marriage between the speculative and the empirical habits, in one which Mrs. Thatcher the politician consistently made much use of. She retained a genuine interest in science, which Dorothy Hodgkin concedes. It equipped her, says the professor. To take serious decisions on scientific matters and 'to see what scientists are doing'. In the politician, her lack of any outstanding scientific talent was less significant than her rare capacity to understand the scientific mind at all…"

For more information see: Agar, Jon, Thatcher, Scientist, *Notes and Records of the Royal Society*, 2011, Volume 65, 215-232.

The Most Powerful Woman (and Chemist) in the World, Angela Merkel (1954 -) Chancellor of Germany 2005 -

German Chancellor Angela Merkel is regularly described as being the most powerful woman in the world. She twice lead the Forbes magazine list of the world's most influential women.

Angel Merkel was born in Hamburg in 1954. Her father was a Lutheran pastor who took the unusual step of moving the family into East Germany, to the town of Templin about 80 miles north of Berlin. Her father took up his pastoral duties in the town, went on to found a seminary, and eventually managed a home for handicapped persons. Her father held what were described as "sympathetic" views towards East Germany's communist regime. This meant he was granted the privilege of traveling freely between East and West Germany. The young Angela therefore had first hand experience of the difference between the two Germanys and perhaps much earlier than many of her peers, was forced to consider what would happen when they were reunited.

After being educated in Templin, she enrolled in the University of Leipzig, where she studied physics from 1973 to 1978. Her diploma thesis was titled, *The Influence of Spacial Correlation on the Reaction Rates of Bimolecular Reactions in Dense Media.* While an undergraduate, she also received recognition for her Russian language and mathematics skills.

After completing her degree, she applied to the Ilmenau University of Technology but was not accepted. She had married physicist Ulrich Merkel in 1977 but they divorced in

1982. In 1998, Merkel married Joachim Sauer, a professor of inorganic chemistry from Berlin.

Merkel worked in the Division of Theoretical Chemistry at the Central Institute for Physical Chemistry of the Academy of Sciences in Berlin from 1978 to 1990. She submitted here PhD thesis in 1986 on the "mechanism of simple bond breaking reactions and calculation of the rates based on quantum chemical and statistical methods". At the time, she also had to submit a second thesis demonstrating her knowledge of the theory of Marxism-Leninism. Sadly, this thesis has not been made public but we do know that her grade for this work was "sufficient."   Merkel then transferred to the institute's Division of Analytical Chemistry.   Unfortunately most of her papers were published in German and the author has been unable to obtain translations as this article goes to press.

German reunification began in 1989 and Merkel soon left chemistry for politics. She was elected to the German Parliament in 1990 and was appointed Minister for the Environment, Nature Conservation, and Nuclear Safety in 1994. In 2000 Merkel was elected head of the Christian Democratic Union of Germany, a national political party with 17 state affiliates and more than 300 local chapters. Merkel was both the first woman and the first non-Catholic to lead the party. She was the party's nominee for the 2005 election and thanks to a coalition with other parties, was elected Chancellor in 2005. She won reelection in September of 2009.

Like Thatcher, Merkel was involved in structuring her nation's future science policy but this process has been complicated by the current European economic problems. Like Thatcher, she was also unafraid to address the issue of climate change. While serving as the environment minister, she participated in the negotiations leading up to the Kyoto Protocol. She also made sustainable development a major policy goal as well as insuring that Germany would become a world leader in reducing greenhouse gas emissions. (see Merkel, A., The Role of Science in Sustainable Development, *Science*, 17 July 1998: 281 (5375), 336-337) However in recent years, Germany has back peddled on its previous commitments to meet greenhouse gas emissions targets.

Because Germany has the strongest economy in Europe during the current economic crisis, Merkel is considered by some to be the *de facto* head of the European Union. What special insights a scientist might bring to this challenge remains to be seen but we can only wish her well.

And In the Confederate States…

There is one more engineer-president who deserves mention.

Jefferson Davis (1808-1889) was the president of the Confederate States of America during the Civil War (1861-1865). He was elected president before the outbreak of the war and was captured by Union soldiers shortly after the end of the conflict.

Davis was born in Kentucky to a family of modest means. He studied at a number of institutions including Jefferson College in Mississippi and Transylvania University in Kentucky. He was eventually appointed to the U.S. Military Academy at West Point. He graduated in 1828 and was assigned to the 1st Infantry Regiment in Wisconsin. He was elected to Congress in 1845 but resigned to serve in the Mexican War as the commander of the 1st Mississippi Regiment. He returned to Congress as a US Senator and then Secretary of War under President Franklin Pierce. When the southern states seceded from the union, Davis resigned from the senate and returned to Mississippi. Although he would have preferred to serve as an officer in the Confederate Army, Davis was elected president of the Confederate States and accepted the office in February of 1861.

Like most West Point graduates of the era Davis was required to take civil engineering classes. During his Army career, He worked on a number of projects including building Army forts on the frontier. He briefly considered resigning from the military to accept an engineering position with the West Feliciana Railroad but decided against it because he considered the railroad's prospects were poor. While Secretary of War he would have been involved in the reconstruction of the US Capitol building. During his years in the Senate, Davis served as a trustee of the Smithsonian. As Secretary of War he initiated the various surveys that were conducted prior to the construction of the first transcontinental railroad.

Our First Chemist President?

At this time the best qualified scientist-politician for the 2020 presidential campaign is probably Congressman Rush Holt, D-NJ, 12th district. Holt was born in West Virginia where his father was the youngest person ever elected to the Senate. He holds a B.A. in Physics from Carleton College in Minnesota. His Master’s and Ph.D. were earned at New York University. While teaching, he also served as a Congressional Science Fellow, and arms control expert. Holt was Assistant Director of the Princeton Plasma Physics Laboratory but resigned that position after being elected to congress. He is also a five-time winner of “Jeopardy.” Bumper stickers in his home district read: "My Congressman IS a Rocket Scientist." For Holt's running mate, a good choice would be Nancy Boyda, former Democratic congresswoman from the 2nd district, Kansas. Boyda graduated with honors from William Jewell College in Liberty, Missouri, with dual degrees in chemistry and education. She began her career in 1978 working as an analytical chemist and field inspector. After serving one term in Congress, Boyda was appointed deputy assistant secretary of defense for manpower and personnel at the Pentagon.