

Elements Of A BYU Education Fundamental To A Rewarding Career In The Sciences - As Seen Through The Rearview Mirror

Dean Sommerfeldt, Associate Deans Griffen, Sederberg, and Johnson, faculty, students, and guests, a little over thirty-three years ago when I completed the requirements for a master's degree here at BYU, I was asked to give a talk at convocation for the College of Physical and Mathematical Sciences. I had accepted a job with Exxon Company, USA and had moved with my wife, Barbara, and our two young children to Houston, Texas. I was unable to return to Provo to speak for that occasion. This day has special meaning for me - to again have the privilege of being invited to speak to the College of Physical and Mathematical Sciences. I am honored to address you at this Homecoming occasion. Today, I will present a rearview mirror look at my career and share what I have found to be the three most important things to take away from a BYU education for a rewarding career in the physical and mathematical sciences. They are: 1) the proper alignment of your moral and ethical compass, 2) the ability to work and communicate well with others in teamwork settings, and 3) the ability to think critically, using the knowledge and training you have received in your chosen discipline.

Following a properly oriented moral compass may bring criticism. If your moral compass is followed with fanfare and you make a big deal of it, you will likely experience ridicule as well as criticism. However, if your moral compass is followed consistently and in an unassuming manner, you will earn respect and trust from employers and colleagues alike. Following your compass will even remove a few of life's complications. After I graduated from BYU with a bachelor's degree, I entered the US Army. During one of my assignments, a mandatory requirement from the commanding officer was for officers and their wives to attend a monthly "Hail & Farewell" social function at the officer's club. After Barbara and I attended our first function, I was surprised to find deducted from my paycheck at the end of the month, a share of the battalion's

liquor bill that had been divided among all officers in the battalion. It was a fairly large sum and impacted our family's living expenses. I appealed to the colonel for relief from the financial burden. I explained that my personal standards kept me from drinking alcohol, and paying for others to drink would compromise my beliefs. I took the opportunity to tell the commanding officer about my personal beliefs and about standards of conduct for members of the LDS faith. At the end of our conversation, he excused me from payment of the battalion's monthly liquor bill. A fellow officer, who didn't care to drink, learned about the results of my appeal. He also appealed for relief from the steep monthly costs. The colonel asked what religion the officer belonged to. He said he was Episcopalian. "So am I", said the commanding officer. "You pay!"

When your moral compass is pointed towards integrity and a hard work ethic, those around you take notice. While attending Army Engineer Officer Candidate School, five of the seven LDS officer candidates in my class of one hundred twenty men held student leadership positions in the company. Leadership positions were assigned to hard-working candidates whom the commanding officer considered as examples for other men to follow. On one occasion my commanding officer, ordered me on to the ground to do pushups. He said to me that half of his company was Mormon and he wanted to know why Mormons were taking over the army. His mathematical skills were suspect because seven out of one hundred twenty didn't add up to half of the company for me. Most of the LDS officer candidates in my company were also BYU graduates and married. Some of our classmates were uneasy around us and one told me he was frightened of LDS officer candidates he knew because they were the most quietly aggressive men he had ever met. However, after meeting our beautiful wives, our classmates were anxious to be lined up with LDS girls from the Washington D.C. area for dates to our Graduation Ball.

If we stray from our moral compass path, others notice it. I worked as a geological consultant for Time-Life Books. While we

were camping in the Grand Canyon one night, a Time-Life photographer told me about a BYU graduate he had met during a recent work assignment. They had been working together in very hot conditions in the desert. He worded his observation in a diplomatic manner. He said that in spite of the heat the BYU graduate drank only one can of cold beer. Wherever you go after you leave BYU, you will be a lifetime member of the BYU Alumni Association. Your employers and associates will be aware of your conduct as a BYU graduate.

When times become difficult and familiar landmarks and guideposts become obscure, a properly functioning moral compass will give direction that can guide you successfully through the storm. I believe that counsel given by President James E. Faust about moral compass direction in an October 1996 General Conference address has broad application for a successful career in the sciences, **“You young (people) are under great pressure to learn the technology that is expanding and will continue to expand so rapidly. However, the tremendous push to excel in secular learning sometimes tempts us to compromise that which is more important ... honesty and integrity.”** President Faust defined honesty in these terms, **“Honesty is more than not lying. It is truth telling, truth speaking, truth living, and truth loving.”**¹ The proper alignment for a moral compass as taught here at BYU coincides well with the search for scientific and mathematical truths as well as for truth seeking in all things. In the words of the eminent LDS scientist, Henry Eyring, **“In this church you only have to believe the truth. Find out what the truth is.”**²

In today’s work place, many disciplines overlap and collaborative work is often necessary. A working model for much of industry today is the interdisciplinary team approach. Different disciplines have methods unique to their own areas of investigation. They each have their own special terminology. Work in interdisciplinary teams goes forward successfully when these differences are understood and strengths of individual

contributions are preserved while the team works together constructively. It is important to prepare for teamwork settings by developing interpersonal cooperative skills. Effective communication skills are essential from beginning to end of each teamwork project. No matter the depth of knowledge you may have in an area of specialization, if you cannot communicate it clearly, your contribution to a team effort breaks down. Effective communication has to take place at the most basic level. The story is told about a man who, while traveling through east Texas, came upon a signpost at a city's entrance that was spelled N-a-c-o-g-d-o-c-h-e-s. Not certain about the pronunciation of the city's name, he stopped at a fast food restaurant just inside the city limits and said to the young lady behind the counter, "I've never been to this place before and I'm not certain how to pronounce its name correctly. Would you please say its name very slowly?"

"Yes sir", drawled the young woman. "Its Burr-gerr King."

The simplicity of this communications breakdown may seem silly, but a few years ago you may recall that the \$125 million Mars Climatic Orbiter mission failed when the orbiter burned up in Mars' atmosphere as a result of a navigation error caused by simple miscommunication between two groups of scientists. The NASA group had used metric units of measurement, while the Lockheed Martin group used imperial units. Here at BYU as you work in group projects, know that the skills you are developing in teamwork settings go beyond understanding facts, theorems, and formulas. It is crucial to a successful career in the sciences to develop effective communication and cooperation skills.

My first assignment as a petroleum geologist fresh from BYU graduate school was in the Gulf Coast area of the United States and the offshore Gulf of Mexico. In my early career, I spent much of my time studying processes of salt mobilization and tectonics. Avery Island, a salt dome shown here in a satellite image of south Louisiana, is not really an island but is a topographically higher elevation than the surrounding landscape. This is where the McIlhenny's make their famous Tabasco Sauce. I worked on

development and production of the oil trapped at depth on the flanks of the salt dome. Exxon paid royalty on the produced oil to the McIlhenny family, a nice supplement to their Tabasco Sauce business. In the early 1970's, the petroleum industry explored for these salt domes and other hydrocarbon targets all the way out to the edge of the continental shelf. I worked for Exxon on semi-submersible drilling rigs and drill ships in 300' water depths about 100 miles from shore. At those water depths, we were using cutting edge technology for the time. Today's technological advances are such that industry is drilling in 8,000' water depths and soon will be in 12,000' water depths many hundred miles out into the ocean. Wells are now being drilled deeper into the earth. Many targets are being drilled below salt intervals. Many of the targets being drilled are due to the advanced technology of 3D seismic imaging into the earth, something not even conceptualized when I was a student here. 3D seismic applications are now part of the curriculum in the BYU Geosciences Department, which has one of the few "state of the art" 3D seismic laboratories available in universities today.

The complexities of extracting natural gas from beneath highly populated areas is something my company has been involved with. The technology of horizontal drilling has improved to where this is now being done successfully over a mile deep beneath the city of Ft. Worth, Texas. This multi-county map in Texas, with an outline of Ft. Worth's city limits, shows wells that had been drilled by 2001 in the Newark Gas Field. A present day map shows wells now surrounding the city. The natural gas field now being developed extends beneath the entire city. In developing this resource, the current practice is to drill vertically down to the Barnett Shale Formation and then drill out horizontally for up to a mile. Horizontal drilling allows for more effective recoveries of hydrocarbons in the earth with less impact on the earth's surface. Several horizontal laterals can be drilled from the same vertical well bore. Drilling horizontally also allows access to targets that are difficult to reach because of other land surface issues like

mountainous terrains or waterway restrictions. Exxon set a record this past year of drilling horizontally for seven miles at Sakhalin Island in the Sea of Japan. Because of ongoing new technological developments, what you imagine doing at the start of your career will probably be quite different from what you can and will be doing at the end of your career. You will be engaged in life-long learning to keep up with advances in your discipline. The knowledge and understanding of facts, theorems, and formulas you are acquiring here at BYU are important. They are basic, useful tools to put in your career toolbox. The application of these tools in a successful career is accomplished through critical thinking and problem solving. Critical thinking within the framework of scientific skepticism has these objectives: 1) effectual acquisition of data or information, 2) decrease risk of acting or thinking with a false premise, and 3) arrive at well-reasoned conclusions and solutions to complex problems.

Critical thinking with a problem-solving attitude should become an integral part of your daily routine. Elder Henry B. Eyring in a talk to religious educators in 1986 told of the time his scientist father helped him with a physics or math problem in college that he had struggled with during the previous week. Seeing the problem had not yet been solved, his father asked him, **“Hal, what do you think about when you are walking down the street or when you are in the shower? What do you think about when you don’t have to think about anything?”** Elder Eyring admitted it wasn’t physics or mathematics. His father then said, **“Well, Hal, I don’t think you’d better make a career of science. You’d better find something which you just naturally think about it when you don’t have to think about anything else.”**³

The ability to develop and cultivate critical thinking and problem solving skills here at BYU is greatly enhanced for an undergraduate student when the opportunity is taken to work on mentored projects with faculty members well versed in critical thinking skills. Mentored-student learning opportunities at other institutions are usually reserved for graduate students. It is a

worthy goal for the College of Physical and Mathematical Sciences, with support from its alumni, to give a mentorship or undergraduate research opportunity to every student who desires and qualifies for one.

In 1835 The Prophet Joseph Smith, in his seventh lecture of the *Lectures On Faith*, explained that when man works by faith, he works by mental exertion and words. It is interesting to contemplate what relationship the faith-directed activity of mental exertion and words might have to critical thinking and effective communication. I have found in my career that mountainous obstacles can be removed from a career path through mental exertion, critical thinking, effective communication, and faith in heavenly sources of inspiration.

Back to my early experiences in the Gulf of Mexico. One of my first assignments was to work on an interdisciplinary geopressure detection team. We were charged with drilling a wildcat well out in Gulf waters. Our vessel was similar to the semi-submersible rig shown here. If we drilled too deeply without preparing our drilling fluids to exceed bottom hole pressures in the earth, we might drill into a high-pressured zone that could cause the well to blow out with risk of injury and great financial loss such as happened to this jack-up rig offshore Egypt. On the other hand, if we overbalanced and increased the weight of the drilling fluids too soon without lining the drill hole with steel casing to contain high-density drill fluids for drilling in high-pressure conditions, we might break down the integrity of the shallow portion of the drill hole. This also could result in permanent loss of the drill hole with great financial loss. Real time decisions had to be made as we drilled. After drilling for several days, the data was not conclusive and our team members were in disagreement on what to do. One team member dropped out of the decision-making process because of the mental and emotional pressures he was experiencing. After weighing all the information at hand, a vote was taken among members of the team on when to place the steel casing in the hole. Much was at stake. It so happened that I was the tie-breaking vote on a plan of

action. Fortunately, we pursued the right plan and the venture was a success. As a new inexperienced employee, I was grateful for the preparation my BYU education had given me for this challenging situation.

Unexpected events often come in a career. An unexpected challenge I found on this particular offshore rig occurred shortly after I arrived at the rig by helicopter. I went to the drilling operations room where I found the working environment to be dismal. Except for the instrumentation panel wall, all of the walls were covered with pornographic pictures. I had no authority to order the more senior people to remove the offensive material. So, when there was a break from monitoring instruments, I took out my pocket edition of the New Testament and read. That evening, I left the operations room for a meal in the galley. When I returned, I noticed a bare space on the wall where some of the pictures had been removed. Each time I left the room for meals after that, I would return to find more bare space on the walls. After two days of reading the scriptures on my breaks, the walls and tables were clear of all pornographic material and I was able to work in an environment conducive to enlightened thinking. When I returned to my downtown Houston office two weeks later, I found that word of my experience on the drilling vessel had reached the office ahead of me. A colleague came into my office and told me that people in the office were talking about how tough I had been on the men on the offshore drilling rig. Of course, I didn't think that I had been tough on them. I hadn't argued with anyone about removing the objectionable material. But, it was interesting to observe how reading the New Testament for my own benefit in that environment had pricked the men's conscience with a light that overcame the darkness of the room.

I spoke earlier of the need for critical thinking to find solutions to complex problems. There is no shortage of complex problems to go around in any discipline. In the petroleum industry today there is great need for application of improved technologies. Complex challenges abound such as the need for better facility design in

preparation for storms in the offshore Gulf of Mexico like the 1992 Hurricane Lili shown here. The double punch of Hurricanes Katrina and Rita in 2005 was the most destructive in the industry's history. Their paths, shown here, went directly through densely developed portions of the Gulf of Mexico, causing damages like those to the Shell Mars Platform shown here.

Solutions to complex problems are, in essence, discoveries. Even though petroleum is discovered in the earth, a saying in the petroleum industry is that "oil is discovered in the minds of men." As you who are chemists solve complex problems in the laboratory or you who are physicists solve complex problems in nuclear or cosmic realms, or you who are mathematicians or computer scientists reach solutions to complex problems in your disciplines, these discoveries will come through application of a faith that the Prophet Joseph described as "mental exertion" and through the efforts of critical thinking. BYU is a great place to develop your critical thinking skills. Don't leave here without them.

In summary, looking back at my career through the rearview mirror, I have concluded that a rewarding career in the physical and mathematical sciences is largely dependant on these three elements of a BYU education: 1) the proper alignment of your moral and ethical compass, 2) the ability to work and communicate well with others in teamwork settings, and 3) the ability to think critically, using the knowledge and training you have received in your chosen discipline.

References

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- 3) Henry B. Eyring. Prepare Your Heart. (Address to religious educators, Aug. 22, 1987), pp.2-3