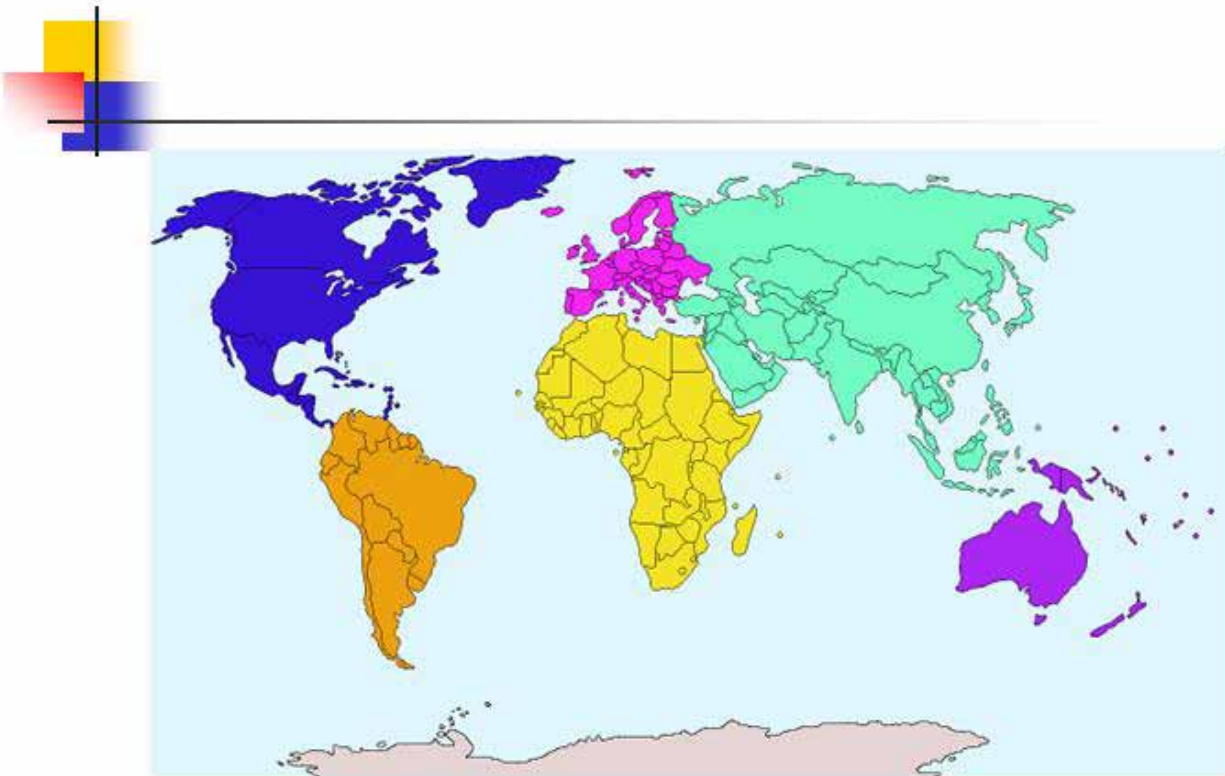


Engaging the World Through Chemistry



Thank you for coming this evening. I want to recognize family, my colleagues here at Westmont and from the broader community and many friends. Let me tell you this evening about what has been interesting and important to me for most of my life, some of which has even involved chemistry.

B.C.



I have to admit that giving a talk to this audience is probably the second scariest talk I have given – I don't think I have given that first one yet,!

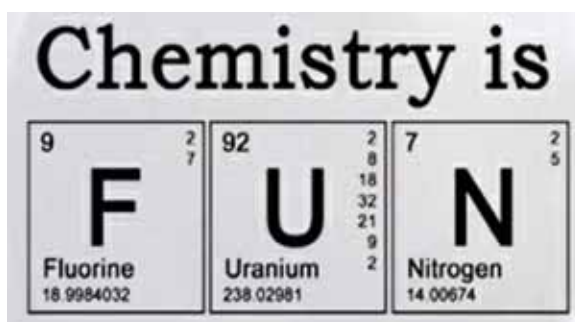
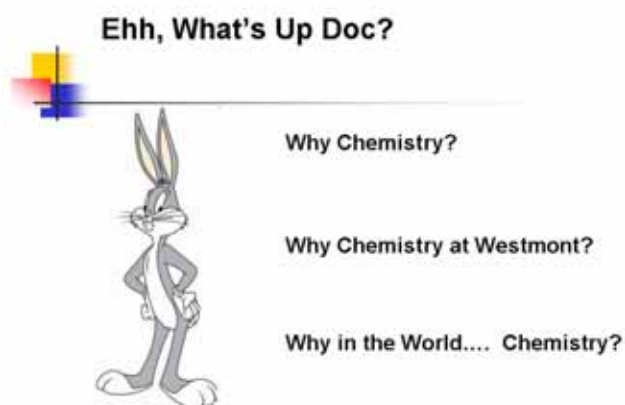
I am saying this because a general talk in the sciences has its challenges. If I only talk about my research I run the risk of losing people in technical details. One can simplify the language but only so

much. I have done this or at least attempted to do this in the past at several Phi Kappa Phi lectures and even sabbatical reports so I will not make a technical presentation again. This BC cartoon sums up the challenge quite nicely!.. I will talk about things which have been fun and informative but it will be in the context of giving credit to my students and to the broader community of chemistry. It dawned on me that I am the first person retiring in the natural sciences who is privileged to address you in a valedictory lecture. Therefore this is an historical occasion at least in terms of setting a precedent so I feel obligated to relate some history in the process.

Why Chemistry?

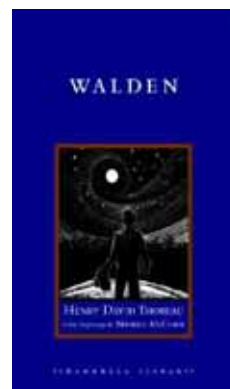
Temperment, intellectual gifts or lack of them, parents approval, teachers and peers encouragement, spiritual growth are all obvious factors.

Let's start at the beginning. Well, birth comes first which goes without saying - to paraphrase Bugs Bunny....(I attribute this to my son Mike}. But that does not determine whether one chooses science. Why do little boys go into science and some even become chemistry professors? My beginning was when I got interested in it in grade school and for all the wrong reasons. For me that meant whiz-bang (ppt) events of a most spectacular nature. The tools of terrorism are appealing. There is a progression that goes something like this... Well not quite! Let's try again with a certain progression....



The chemistry experiment kit I got for Christmas, the radio my dad and I put together preceded the pyrotechnics. I give much credit to my father, an engineer by training and subsequently an inventor and businessman who helped me develop hand-on skills as well as curiosity and perseverance. He obtained all the chemicals I requested. Glycerine, nitric acid, ammonium perchlorate, etc. I wish he had known more chemistry – I almost killed myself more than once. Teachers who imagined I might do well in science also come to mind Clarence Culver the formidable superintendent of my grade school mentored several of “his boys”. Three of us who shared his attention were bound together in scientific friendship. I remember half joking with them about starting a business! I was the aspiring chemist, my friends - a would-be doctor, and an undertaker, respectively. I think you can see where this is going. I blow up or poison someone, the doctor pronounces him dead, and the mortician buries him! ... Somehow I think I got left holding the bag; How could I make any money out of an arrangement like that?? The others can collect their fees. I would go to jail or to the electric chair....

I had the great fortune of attending outstanding high schools in the Chicago area where I developed the next step - a love for learning. I recollect buying a paperback for an English course and it was a Eureka experience (Thoreau's *Walden* – it was purple; I held it in my hand with the naïve thought that books like this one meant I could learn anything and everything, and I believe that I tried to do just that!). All the courses I was taking seemed a joy. This was the beginning not only of library acquisition but of my interest in the liberal arts - all subjects. Chemistry was a growing interest but not the only interest.



Considering colleges, I was aware of Wheaton alums in my church. I don't know exactly when I got interested in attending Wheaton College; but meeting Dr. Bernard Nelson in the chem. Dept was key. He worked summers in Skokie for GD Searle, the pharmaceutical company, which had given me a scholarship. I decided to use it at Wheaton which provided a great chemical education as well as intellectual exposure to a wide range of subjects.



My senior year was particularly memorable. It followed a summer at Northwestern where I did undergraduate research and got excited about inorganic chemistry. Back at Wheaton, I had enough elective units to spend a third of my time doing senior research with Professor Nelson. who tutored me in an advanced organic course on the side. This was very unusual and really irritated another faculty member whose course I avoided. I remember taking Romantic literature with Clyde Kilby, initially responsible for Wheaton's C.S. Lewis collection; and one who reportedly would weep over the footnotes in Lewis. The wood of the true wardrobe, however, belongs to Westmont! Kilby sparked my enthusiasm for imaginative literature. Capstone courses like history and philosophy of science pulled my science education together by giving perspective. A good scientist has to be an historian, but not only an historian, a philosopher on some level as well but not only a philosopher. What do I mean? A chemistry teacher can become only an historian of science unless he actually does science, namely research in his field, and chemistry majors are not really chemists unless they can do chemistry. This is powerful motivation for our own scholarship and one reason we try to engage our students in research. Dr. Joseph Spradley in the physics department at Wheaton was my senior honors thesis advisor and mentored me in these subjects, we became good friends, and this continues to this day. It helps Joe has a son Ben in Santa Barbara – Westmont alum - and that we regularly visit the Wheaton area!

It took a while to consider teaching. I worked at GD Searle during most of the summers I was in college. I could have been very happy with a career in industry or government as a researcher. Half the time I was at Wheaton I admit to some doubts about pursuing chemistry as a vocation (Is this really my best career choice???) Maybe it was too consuming a passion that might lead me down a spiritually dangerous path, or even become mad scientist. A severe case of mono my junior year was the opportunity for some serious soul searching about many things including career. A lot of prayer, good advice from pastors and friends, and a time of spiritual renewal gave me considerable confidence and peace about staying the course. A close friend starting gently moving me in certain paths of Christian discipleship so I was also starting to take the great commission seriously. I remember a particular chapel and the scripture about someone putting his hand to the plow and looking back, not being fit for the kingdom of heaven. That got my attention; commitments to God were solemn promises I should not take lightly. The commandments are not just suggestions. No guilt trip, just a decision to follow a certain path.

So by the time I got to grad school at the University of Illinois in Urbana I knew teaching chemistry was my goal. I also learned to love doing research in chemistry and did it with some of the greats. Learning to “listen to the molecules” is part of engaging the world of my profession and is a bottom line value we try to teach our students. I have always had a great deal of infectious enthusiasm for this. But one must be properly trained.



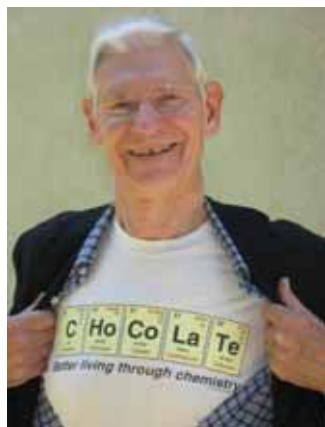
Why Chemistry at Westmont?

How did I end up here? I was teaching at UC Riverside when I learned of a chemistry position open at Westmont. Out of the blue one of my old professors at Wheaton called and informed me. But I did not feel it was the right time and did not apply. A year passed, the position was still open, and I changed my mind and applied. I was invited to come for the usual intense two days and was met by Cliff Benton at the airport. Cliff by the way had taught chemistry in Afghanistan so we hit it off immediately given my interest and time in the Middle East, but more on that later... Arriving at the chemistry department the next day was a real shock; it was housed in an old garage! --And not the remodeled facility that physics used until the fire.

Why did I come? It wasn't the scenery, although Santa Barbara was almost as nice as some places we called home in the Middle East! I was impressed with people like David Winter - who envisioned a new science building in a few years! And dedicated faculty like David Neu, Frank Percival, George Bate, George Blount, Stewart Ensign, all known by some of you, and Cliff. There were 6 nat sci faculty at the time: Frank and I are the 2 remaining. I saw a lot of potential – where else could the program go but up! This appealed to me as a visionary. The opportunity to hire new chemistry faculty happened my first year when Cliff had bypass surgery and was unable to return to Westmont. Within a few months of arriving I was alone with a few part-timers. We immediately advertised a replacement position. Tom Andrews was the new dean at that time and was most supportive of building up the science departments. Allan Nishimura accepted an offer and came in 1980.. Dave Marten came in 1983. By this time plans for a new building were in the works which we designed to our specs and moved into in 1985. Now that was an exciting time for 3 young faculty which culminated with not only an attractive, new facility with new state of the art equipment, but the ability to project a quality program as never before to perspective students. That is an ongoing challenge to which Niva Tro, Steve Contakis and Mako Masuno now inject youthful ideas and boundless energy!

Westmont also had a few off-campus study programs in 1978 and I was assured that the College would be supportive of my interests in international education – an assurance which was fulfilled more than once. The presence of UC Santa Barbara in town was not so much of an initial attraction, but it did become an increasingly important part of my professional world and of the students who worked with me as I discovered connections with UCSB chemistry faculty.

I wanted the chemistry I did at Westmont to be useful and significant. For example, This superhero can even use the chemical elements to make chocolate! Now that's useful! You are probably wondering if I am wearing that T shirt now – I am not saying! But alas, superheroes don't last forever...



A goal was to involve students in collaborative research on projects of broad interest and relevance. I chose projects which could also do double duty, namely, getting me up to speed in fields I needed to learn better in order to teach competently and to which I had little exposure in graduate school. In a small college, one has to teach well beyond graduate school preparation. This is a real challenge because the subfields of chemistry are quite distinct.



Superman in his later years

I think Allan, Dave and I have taught most of our courses except for two or three. I have not taught organic or biochemistry. Sometimes we have to teach well beyond our disciplines. I did get recruited to teach intro to math for several semesters and earth science.



This is the time to give credit for several projects to my students, UCSB colleagues, and other collaborators some of whom are in the audience tonight. I am deeply indebted to people who gave me the chance to deepen my understanding of surface chemistry, electrochemistry, solid state nmr, atmospheric chemistry, polymer and even a bit of biochemistry, and the latest experimental techniques. Let me give some brief examples of projects accomplished which have engaged the world of chemistry.

New types of batteries are required for electric cars. We had a lot of fun working with the Kennedy group at UCSB to study solid state lithium materials which

were good conductors and used to make commercial lithium batteries. John was consulting with Union Carbide/Eveready at the time and our goal was to study mobility of lithium ions in these materials, now incorporated into the small cells which power cell phones cameras, and a host of small electronic devices. Mark Rogers the Westmont student who did a lot of this work, used nuclear magnetic resonance

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 106, NO. D11, PAGES 14575-14581, JULY 10, 2001

Design, calibration, and performance of MICROTOPS II handheld ozone monitor and Sun photometer

Marion Moroy¹
1Sea Light Co., Inc., Philadelphia, Pennsylvania
 Forrest M. Mies III and Scott Hagerup
2University of Utah, Salt Lake City, Utah
 Bradley E. Anderson, Aaron Baker, Jesse Kim, and Travis Walling
3Western College, Santa Barbara, California

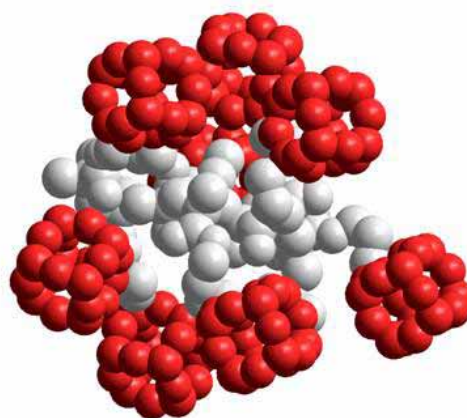
Abstract. MICROTOPS II is a five-channel, handheld Sun photometer that can be configured to measure total ozone, total water vapor, or aerosol optical thickness at



(a similar machine is used in hospital imaging) to study ion mobility.

My analytical chemistry classes and several research students (Aaron Baker, Jessie Kea, and Travis Walkup) developed accurate calibration methods for a handheld sun photometer called Microtops for measuring ozone. Forrest Mims, formerly of Scientific American Amateur Scientist column fame, invented the unit, but needed help in calibrating it accurately against the world standard instruments. We succeeded developing a detailed procedure and Microtops is now manufactured by the Solar Light company in Philadelphia. Only \$5000. An interesting story is that one of Forrest's initial publications reported measurement of the ozone layer which seemed to indicate that the Nimbus ozone satellite was systematically drifting. The World Meteorological Organization and NASA (which discovered the ozone hole over Antarctica) are responsible for monitoring ozone and questioned data obtained with our "toy", but they checked into the matter. Sure enough we were right. After a few years NASA personnel started using Microtops routinely in the field to confirm their satellites and to develop better equations for calculating ozone from satellite data.

Finally, I have worked with Prof. Mike Bowers at UCSB on hybrid organic/inorganic plastic materials with useful applications. Polymeric materials look like they have a random structure like spaghetti (let's put "meatball" cages in) but it is possible to examine underlying structural



POSS "Meatball and Spaghetti" Polymer

features by measuring how fast ions derived from different molecules in the mix travel through helium gas. This is related to their mobilities. A good analogy is downhill skiers. You may possibly recognize certain members of the chemistry department. We can separate molecules based on their mobilities like skiers in a downhill race. We have learned to correlate the measured "shape" with calculated shapes based on theoretical modeling. These useful materials have numerous space applications and dentists have adopted them for tough dental acrylics. I sport the latest on my two front teeth! Retirement will shortly involve me in a new project for the Air Force to study metal oxide catalysts by similar techniques.

Mobility and Identity??



Ion Mobility Experiment



Why in the world... chemistry?

For the final part of this talk I will revisit the broader world and how chemistry was an entrée' to it.



Urbana, Illinois where I went to graduate school, of course, has another association. It was the site for many years of Intersvarsity's triennial conference on world missions (only a dim awareness when I was a Wheaton student). So in 1967 as a grad student I attended the sessions on the Muslim world and non traditional missions and discovered quickly that there were many new universities around the world which even hired foreigners in their attempt to get established quickly. At the beginning of this I said that international education was

talk

part of my vocational calling to teaching from the very start. That history includes several important details that were crucial in the direction I went. Several of the Wheaton physics faculty I knew took leaves of absence to Africa and to the Middle East to teach in universities. Dr. Joe Spradley mentioned earlier was one of these people and spent 3 years in Nigeria and then 3 years in Beirut, Lebanon. They were models of Pauline tentmaking I wanted to emulate. Having Joe as my senior mentor connected our careers. I have always wanted to the same for my students.



Pahlavi University, Shiraz, Iran



In 1969 the year I got my PhD, I applied for university openings abroad without success so I went for more experience with an intent to keep applying. Encouragement came from friends at Wheaton and Intersvarsity who took jobs in Iran and communicated opportunities in that country. I eventually ended up in Iran for 4 years, taking my young family with me. I had a direct contract in the chemistry department at Pahlavi University in the beautiful city of Shiraz. The University of Pennsylvania reorganized this university and brought in many American faculty some of whom were Christians. We immediately

became involved in the Anglican community and began reaching out to our Iranian fiends and colleagues. Teaching and research were especially rewarding because I was able to help young Iranian profs get established. I even taught graduate courses.

This was a wonderful experience for our family. We developed deep friendships with Iranians and many in the expatriate community, mostly Europeans. We got into the culture, learned Farsi at least well enough to survive. After 4 years it was time to leave, and good thing we did. The Lord opened up a job at UC Riverside. The Iranian revolution followed quickly and all of our friends were evicted from the country. Several Iranians on the chem faculty took positions here in the U.S.

I will briefly mention the other opportunities to teach abroad. I was offered a Fulbright lectureship at the University of Khartoum in Sudan in 1985 - 86. This was a real adventure; there was gunfire in the city at night fairly routinely when we arrived. The mood (at least during the day!) was jubilant as the country looked forward to free elections. A Sudanese Christian subsequently obtained a Fulbright and spent his sabbatical at UCSB. A few years later this Sudanese connection led me to a meeting with the British dean of a new university in Oman. We met at the Roosevelt Hotel in Hollywood, hit it off, and I got an invitation to join the chem department for 2 years as the chair. I had the unenviable task of presiding over a curriculum revision and transition from the British system to an American liberal arts program and credit unit system. You think accreditation is a challenge. The Brits never could figure out how many significant figures were in a GPA!



It is really amazing how one thing leads to another. As a side note, I started getting interested in



geology while in Oman by going on field trip with geology faculty. On returning to Westmont, Gayle Tucker asked me if I could teach earth science for our ed students since California put in a new requirement for such a course. I taught it for 10 years, but had to go to SBCC to sit in on earth science courses and went on many of their field trips. Some of you took the Hendry's beach field trip with me last spring. Maybe you are in this picture.... I am thinking of doing one on Santa Cruz Island sometime. Anybody interested?

After several attempts I was able to lead a Westmont Mayterm in Egypt with Richard Cahill who ran the Cairo program for the Coalition of Christian Colleges and Universities. We had to cancel two other times because of terrorist attacks in either Egypt or Israel. While in Cairo I had some free time and went over to the American University in Cairo or AUC to visit the chemistry department (I made a similar visit in 1986 on the way out of Sudan). I met the faculty and the dean of science and hit it off with him because of a mutual friend. Joe Spradley from Wheaton had spent a leave there and had done a great job for them teaching guess what, history and philosophy of science in a gen ed course called scientific thinking! He asked me if I could do "scientific thinking" and maybe a course in chemistry to cover someone going on sabbatical. So I got an offer to teach at AUC during the 2000-2001 academic year. It was an amazing time of connecting with friends who we had met on our other stints in the Middle East, Iran and Oman, some of whom had become AUC faculty members.

I cannot fully express how life-transforming these experiences were for me and my family. Chemistry was an exciting way to make positive, meaningful contributions to the departments I visited. Many friendships resulted. Living as a foreigner is a humbling experience and the spiritual lessons of learning to trust God and friends for the simplest things are unforgettable. I am not unique. Many in this room have expertise to go almost anywhere. That is one reason those of us who have had Fulbrights keep reminding you of the deadline to apply!

My children can never be the same after living in these countries. International schooling put them ahead of where they would have been had we not gone. Adjustments were not easy for them, but all would say how much they benefited and learned to understand a much bigger world than they could have otherwise. Suzanne had many opportunities for volunteer work in hospitals and orphanages.

There is always a down side when you leave a place for a year or more. Relationships at home move on without you and you feel like a stranger when you return. Reverse culture shock is very real and is very disorienting. Who do you talk to? Maybe you should not talk to anybody for fear they would not understand. I hadn't realized my symptoms until I had an opportunity to sit in Laura Montgomery's orientation course for Westmont in Mexico just a year ago. It's never too late to learn....but then you retire.... I think faculty who go on off-campus programs need to be aware of this and be thoroughly oriented cross-culturally just as much as our students.

My title almost was "Engaging my world through chemistry." But I think "the world" is better because "my world" is always too small. Our students' world when they come to us is too small as well. We really do want them to engage "the world" and this is reflected in the new GE requirements. "World" means more than the geographical world - the whole creation, humanity, of course different countries and cultures, language and thought patterns. At least those aspects. Very liberal artsy! There is a down side, however as in the "world, the flesh and the devil." We want them to choose the good, the beautiful and the right world with some guidance as to what they experience, and reject the same world system which our Lord rejected But they have to be exposed to both

So I offer some suggestions that may prove useful as many of you in this room are now or will be involved with a new emphasis on globalization at Westmont. Many of you are deeply committed to our off campus programs. I know our new president is as well because it came up in our first minutes' of conversation in my initial meeting with him. I am not presuming to know exactly how the discussion will go or what the outcome will be in terms of new Westmont programs. I do know Gayle Beebe has initiated a taskforce to begin the discussion.

For me the Westmont discussion started 31 years ago when I arrived on campus. My first committee assignment was on the old international study committee with Judy Alexander and Ed Potts. We made a detailed proposal and recommendation that every Westmont student be required to have a cross cultural experience broadly defined. It could be met with one of our existing programs, or at San Francisco or at similar program in the Coalition of Christian Colleges. We especially recommended residential programs to maximize the benefits. This idea did not go anywhere in 1980 because we were struggling with enrollment, had 800-900 students, and needed every student on campus. We had to wait.



August 1, 2009....



So this will be your challenge. What kind of new off-campus programs best serves our students. Let's build on what we have and work on new residential possibilities. Resources will be an issue. San Francisco is a great model and now Westmont in Mexico. Do we want to dedicate faculty to new programs who are always on site? One does get continuity that way. And it allows us to hire people with the right skills, including language who can administer such programs. This would solve the cultural adjustment problems I faced in going and returning. Bob Wennberg challenged us in his valedictory lecture to stay thoroughly "evangelical." Mine is to be thoroughly missional in everything we do for the glory of the One whose resurrection we celebrated a few days ago.

Globalization is something I would like to see happen. I did volunteer to stay on the taskforce so maybe I will still be in on the discussion.

You know by now that not only has chemistry been an enjoyable and even useful field in which



to work but that I really do love chemistry. I facetiously said so earlier. But life has taught there are more important things to love. It is better to love my family, the church, my neighbor, and my Westmont and UCSB colleagues – the very world God also loves. Study of the created universe is fun because it has meaning and significance, but it is best to love the God who made and sustains it, The jewel in the crown of a liberal arts education is to know and to love God. Is this not our highest aspiration for ourselves and our students and for our world? I think I have learned to do these a bit better because of you, the amazing people in this room. So as I ride off into the sunset, that's

me on the camel, I may officially be leaving Westmont, but Westmont is not leaving me.

So I thank you all once again for sharing this time together.