

BZS Speech to BCCE @ U of Michigan

August 1, 2000

Thank you very much, Brian. Good morning everyone. It's an honor for me to be asked to be a speaker at this conference. I want everyone to know, I think some of you know this, I have been to all of these conferences except four. It is really a special joy for me to be here this morning. I want to congratulate Brian, and Sayhan and all of the organizers of this highly successful conference. It is really a tribute to the success that chemistry education enjoys these days and I have more to say about that in a moment.

I'd just like to say, right off the bat, that the status of chemistry education is good, but not good enough. And I'll say more about that shortly. This talk this morning is in part a reflection on what has happened in the past thirty years, but more importantly it is really an attempt, on my part, to participate with you, in shaping not only what can happen in the next ten years, but what should happen.

This being a morning talk, you are not expected to say any after breakfast joke. Is there any such thing as an after breakfast joke? I promise you that. as King Henry VIII said to

each of his wives, I promise that I won't keep you long. It works in the morning too...that is the first time I have used it in a morning talk.

The Sixteenth Biennial Conference on Chemical Education has about 1600 people in attendance. The fourth Biennial Conference on Chemical Education had about 400 people in attendance. Actually, I'm rounding off, we had about 450 and we now, don't quite have 1600 here. And as a token of appreciation to Brian and Sayhan, I brought with me the sign we had in 1976. How many of you were in Madison in 1976? Or are willing to admit that you were in Madison in 1976? Yes, this was the ACS Division of Chemical Education Biennial Conference on Chemical Education and the theme was Participant Paced Programming. This was our logo. Do you remember that? We also had a centennial of the ACS and a bicentennial of the country. So, Brian I'd like to ask you to receive this and perhaps you can help start a tradition of keeping in an archival fashion such memorabilia from conferences. I think the division owes it to itself to record the history of these conferences because they have become so successful and so important. I also have here, in comparison, to your program booklet which has 632 papers numbered, I also have the pocket program book from Madison, so this is for you too, Brian. But this one is for me because I am using it.

I know you can't see it from out there, but I have a small pin. For those of you who were in Madison, you may remember we had this pin. I am wearing it now. So, Brian I'd like for you to have this one also. Don't prick yourself with it. And for anyone who was in Madison in 1976 and would like to have such a pin, I have about a dozen and a half here. Anyone else who would like to get one, if there are any left, please come and help yourself. I'll give them to Brian to deal with.

I did bring with me, also, something I would like Brian to have. It is a mug. It says on it...what does it say Brian. "It says Brian is the program chair, get to your talk". "It says, Science is Fun, In the Lab of Shakhashiri". I have another mug for Sayhan here, but before I pass it on to him, I'd like to ask the audience, do you suppose there is a way for me to hold the mug up on the air without me touching it? Come on you were lively just a second ago. Well, your thinking about what I asked you. A lot of these questions are questions that require thinking. Now, do you supposed there is a way for me to hold this mug up in the air with out me holding on to it? Yes. We say yes, because we know from experience that that can be do. Now, some of you are either saying no, or not responding. I'm going to show you how this can be done. What were the colors of Michigan? Is this one of them? I'm sorry I missed that comment. What was that comment? I have exploded too many hydrogen filled balloons in my life, my hearing is going down.

Here is how you do it. You take the balloon, put the balloon inside the mug, inflate the balloon. Ta da! So, what is it that held the mug up for a while? What would you say is responsible for holding the mug up? All kinds of answers. Good. I brought with me a beaker. Except for the fact that I sawed off the bottom of this beaker, it is a normal beaker. Now, I'll ask the same question. Do you suppose there is a way for me to hold this beaker up in the air without me holding on to it? Yes or No. More yes's now than before. Now, I'm going to take the other color that Michigan has and do it. Those of you who mentioned pressure can pretty much forget about that, because the pressure here is the same as the pressure out there.

It is not possible for me to do a presentation without me doing an experiment. Now that we have gotten that out of the way...we can get to assignment for today. I think what I will do is take my jacket off. It's kind of warm here, is it okay if I take my shirt off too? It sure is okay with lots of people because you all know what the message is. Right? And if I didn't do that, you wouldn't let me get by through the day. Okay so here it is, now we're in the proper uniform.

What I'd like to do today is share with you some observations and some convictions about teaching. Because we are teachers. So the title of my talk...The Privilege of Teaching and Exhortations for Good Teaching". Anniversaries are time

markers. They make us reflect on what we have done and help us organize in a better fashion what we are going to do next. And so, I'd like to pay tribute to the environment in Madison because when I went there in 1970 as an assistant professor, the environment that I found was nurturing, and was supportive, and was very collegial. That contributed a great deal to the development of the chemistry education programs there and eventually elsewhere. This environment promoted integrity. It promoted scholarship and promoted respect. These are words that are important to me and that's why I share them with you this morning. As we look back, rather quickly, at the number of things I have been involved in. Here is a partial list of them. I want you to read every one of them carefully because in the allotted time that I have I want to make sure I cover all the points that were assigned to me.

All right even though there were three of them each one does not correspond to things in a different decades. These are things that were done in the past three decades.

I believe that teaching is a privilege. We are privileged to be part of an effort whose purpose is to enable students to learn. Now, I'm going to talk about that in a moment. I want to talk about something that I was reminded of yesterday when I heard a talk mention the word mentoring. This is a quotation, that I think showed up in Science. It says, "I tried to teach

Fermi to fish, and it seemed to me that he liked it. However, when he returned to Los Alamos from Chicago with a lake fishing rod and reel, I told him that was not suitable for mountain streams but to know avail. Fermi developed a theory on how trout should bite and how to catch them. The theory was disproved by experiment. But this did not impress him in the least. Ultimately he abandoned fishing, but not his theory.”

I'd like for you to think about that, and about the attitudes that we convey to our students. As we communicate chemistry with them. As we try to teach them and have them learn chemistry.

I'd like to ask you a question. It may sound like a rhetorical question. What is the one thing that you would say that differentiates our society now from society say, fifty years ago, a hundred years ago, or a thousand years ago? What is the one thing that differentiates our society now from all previous societies? Yes, all of these answers are beginning to bubble up. And I'll share with you in a very quick fashion, what my response is to that question. Science. Science. All the advances that we have made in science, all that we enjoy now in society is the result of science. Science and technology. I want to put my remarks in context here, as I try to share with you some of these opinions and convictions that I have.

So I want to quote, Freeman Dyson. You know one of the worse things that a speaker can do is to put a transparency up and proceed to read it. It is an insult to the audience. However, with your permission I want to read this. Because when you read something you put your own emphasis and so on. He says, "Science is a hexagonal mountain with six faces. The three beautiful faces of science are science as subversion of authority" Did you know that you were engaged in a subversive activity? Yes you did. You may not have verbalized it but you probably realized it. Science is an art form and science as an international club. He goes on to say, "Science is presented to our young people", that's what we do, we make those presentations, " as a rigid and authoritarian discipline tied to mercenary and utilitarian ends and tainted by its association of weapons of mass murder". He's a physicist so he knows what he is talking about. Although a lot of that applies to what we have done in chemistry too. "The way to attract young people into science is to show them all six faces and give them freedom to explore the beautiful and the ugly as they please." The key word, in addition to science in this transparency, is freedom. Give them the freedom to learn and to explore. Freeman Dyson goes on, in a different book, in 1977 he says, "The failure of science to produce benefits for the poor in recent decades is due to two factors, working in combination. The pure scientist has become more detached in the mundane needs of humanity and the applied scientist have become more attached to immediate profitability." And you know, that is going to happen more as

we have more great advances in what area? Biotechnology, yes. That is going to happen even more that it has already.

Well, privilege. I said we enjoy a privilege. Here is one dictionaries definition of privilege. "A special advantage of immunity or right or benefit not enjoyed by all. " We are a privileged group in our society. Because of a lot of different reasons that I want to share with you this morning, or some of them this morning any way. I submit in what we do in our classrooms and outside the classrooms, we should be very clear about the purposes for which we do it. So clarity of purpose is very important. What is the purpose of having this conference? What is the purpose for which you do, whatever it is that you do in the classroom, and outside the classroom? I submit that many of us do not pay enough attention to the need that exist to clarify the purposes for which we do what we do. So I'm talking about clarity of purpose not necessarily unity of purpose, although that is important too. But clarity of purpose is what I am talking about now. So let me share with you very quickly what I consider to be the purpose of education. It is to enable individuals to fulfill their human potential. These purposes that I'm going to share with you now are in headline form. We can discuss each one of them in great detail as time allows. But let me just share them with you in headline forms now. The purpose of education is to enable individuals to fulfill their human potential. What is the purpose of research, you might

ask. The purpose of research is to advance knowledge. Period. The purpose of research is to advance knowledge. What is the purpose of technology? The purpose of technology is to advance the human condition. It is a very important set of ideas that help us focus on the purposes for which we do, whatever it is that we do. How many technologists or engineers do you think subscribe to this notion that what they do has a purpose of advancing the human condition?

We communicate chemistry in a variety of ways. Let me share with you how we do that in a rather quick fashion. We do it in a formal setting. We do in a classroom. What is a classroom, by the way? The other day I came across a statement that Joe Schmuckler shared with us. A classroom is a place where instruction takes place, with or without learning, he said. Lots to think about. We communicate chemistry in the classroom, through journals, through publications, professional meetings. This is not an all exhaustive list, just illustrative. We communicate chemistry in informal settings, on the radio, television, the web, the print media, schools, shopping malls, museums and science centers, political conventions, the state government, Halls of Congress. How many of you have communicated science at a political convention? Raise your hand if you have done this. Look at the back of my shirt here. You can't read it from the back of the room. This shirt was distributed by what is now known as the American Council of

Chemistry which used to be known as CMA, the Chemical Manufacturers Association, when they held a session at the 1996 Democratic National Convention. We tried to communicate science in that setting to the delegates at the convention. Of course, we communicate chemistry, informally, during National Chemistry Week. A very very important activity that we do. In fact every week should be National Chemistry Week and that should be something that we should all try to think about.

Now what I'd like to do is focus the discussion on what it is that we as teachers do. What it is that we as teachers do. What we do in the formal classroom setting is we seek desirable outcomes. We look at what it is that we want the students to learn. We set expectations. These two are the what that we do. We also develop strategies. This is the how part. Most of us spent most of the time on the strategies segment than we do on the what part. I'd like to suggest that we try to focus on the clarity of purpose for which we do what we do and what it is that we would like to have as a desirable outcome.

We look at the characteristics and attributes of the students. We look at those characteristics and attributes and we try to provide them with value added experiences. To me that is the biggest purpose for which we have students in our classrooms. They have different backgrounds, different motivations, and what we should do is look at the value added

experiences that we provide them. That to me is the fundamental goal that we are after. To change their attributes, change their characteristics. If you didn't think you could make a difference in a student's life, why are you in front of them in the classroom or with them in the classroom? We do influence their lives a great deal but we need to know where they are and we need to have a clear notion on the desirable outcome that we are after. We look at student achievements. We even define what we mean by achievements. Most of the time we define it by the grades and the grading scheme that we provide them. We should also be concerned with the consequences of what we do with our students. Not only the good consequences but the bad consequences. What are the consequences of whatever it is we do in the classroom and how it is we do it. And are these consequences being attended to as we modify the strategies if the desirable outcome is not being achieved. We provide encouragement to students. We provide rewards, we reward their achievements. And we do a whole bunch of other activities. But, you know what this list also applies to us, as teachers. We should define the desirable outcomes for ourselves. As we go through what I urge you to do periodically, by that I mean every three to five years, to consider and think about what it is that you are trying to do with your students and make a list of that. Review that list. In some fashion you might think about communicating that list to your students. Think about the different entries that I have included here. What are the consequences of failure on my part when I try something

new with my students and it doesn't work? What are the consequences? How should I make an adjustment? How should I abandon, perhaps, what I have done? So these are some of the ideas that relate to what happens in the classroom.

We of course, try to get our students to develop, what we call problem solving skills. We want them to solve problems. I don't mean just the problems that are in the text book, at the end of the chapter. But, we want them to think in a critical way, and be able to access and evaluate, not only information, but knowledge. I make a distinction and I know most of you do, but not all of you do, between information and knowledge. CNN Headline News is information. It is not knowledge. So I submit that we do something else, and we should be doing it, if we are not, we should provide the students with the ability to exercise good judgement. Good judgement. In my opinion, life is about good judgement. Not just judgement, good judgement, and how we develop the ability to exercise good judgement and how we share that with out students and others in the community that the students are in and we are in is an important part of our task.

Now I'd like to share with you, very quickly, and I have done this in previous occasions, but, I'd like to share it for the benefit of the people who have not seen it before and for those who have seen it before, just to emphasize it. The

characteristics of good teachers. So, I'm going to talk about good teachers for a moment. Good teachers are competent in the subject matters that they teach. People often ask me, "Bassam, why do you bother to include this characteristic?" It's such an obvious characteristic. Not only do I include it, I insist on including it because we have to maintain our competence in the subject matter in order to be a good teacher in my book. We have to also be committed to the discipline and to the profession of teaching. It is a dual commitment. You and I know a lot of competent people in chemistry and we know that many of them are not good teachers. That's because they lack the second commitment to the profession of teaching. Good teachers are comfortable with the methods and techniques that they use. It doesn't mean that as you learn a new technique and as you begin to apply it, it doesn't mean that you might not experience some discomfort. But, what I'm saying is the discomfort has to go away if that method or technique is going to be effective for you. And I'd like to remind you very quickly that the difference between being comfortable and being complacent is a very thin line. The fourth characteristic of good teachers is they are compassionate with their students and with their colleagues, he says, parenthetically. This notion of compassion is very important to me. Of course, it's important to me otherwise I wouldn't put it up here and talk about it. A very early version of this, says the fourth characteristic was passion. Passion for students. Some people misunderstood what I meant by that. But that is what I really meant. Caring about their well being,

about their learning, the conditions under which they learn. What they learn. How they develop. How they change. How at the end of the semester I can develop some tell tales to tell me something about what has happened to them as a result of being in my course. I will tell you right now, in my large class at the U W Madison, I tell the students, that the criteria for success for me, as their chemistry teacher is this. After they finish with the course, if I see one of them walking on the street with a friend and I stop them and ask them about something written in the newspaper, it doesn't have to be the Tuesday section of the New York Times, anything in the newspaper about science that I would be able to tell from the way in which they field the question which one of them was in my class and which one of them was not. I hope that you will agree that this is a very tough criteria to set for oneself, but that's the criteria I have set for myself. Not the specific facts, but the way in which they *field* the question, the way in which they approach the question is what I think is important. So, I can't help but remember the 1974 Biennial Conference on Chemical Education, where Paul Saltman, who died almost a year ago, talked about a hierarchy of activities that we deal with in the teaching of science, and I borrowed that from him, and I'd like to share it with you now. In teaching science, in teaching chemistry in our case, we are engaged in a hierarchy. This hierarchy consists of several levels. The first one is, we deal with chemical fact and phenomena, a simple example of that, we learned that the formula for sodium chloride is NaCl, we learned that it is soluble

in water, that its solution conducts the electric current. We move on then, and we deal with chemical models and chemical theories, we say it is an ionic substance, it consists of sodium ions and chloride ions and we talk about electrostatic attraction. We develop a theory for the conductivity properties and so on, and as you all know it is controversial in our field as to which one of these comes first, I'm showing you my bias. We start off with making the observations, validating the observations, trying to make some sense out of these observations, describe them in an intelligent way, and see if the description fits into additional observations and we can modify them.

We're also engaged in this hierarchy in developing chemical skills, and chemical skills are of at least two varieties. There are laboratory skills, the ability to manipulate equipment and chemicals safely, not just in the simulated way, am I showing a bias here of some sort? I don't want to mince any words about this. The ability to have what we now call 'hands on and minds on' experiences in every science course that is taught in this country and everywhere else around the world. We need to develop skills to handle the material safely. And we need to display to our students the ways in which that can be done. The second skill, as I said there are two varieties, the second skill is reasoning skills. The ability to reason things out. To think about that number they punch on the calculator and they tell you the answer that the atomic weight that they calculated is 0.00357.

It doesn't make any sense. We want them to think about what it is that they do. So they don't simply say that, 'I made a simple math error'. You know it's not a math error, it's a conceptual error.

We move on in this hierarchy to something that Paul Saltman called epistemology. How do we know what we know? What is the fundamental basis of knowledge. How do you know that the formula for sodium chloride is NaCl? Why isn't it NaCl₂? Or Na₃Cl? Well, of course, we know that because it says so in the book. Well where did the author of the book get it from? The author of the book got it from some publication and the literature. Where did the author of that publication get it from? What sort of reasoning, what sort of examination of evidence did they go through to come up with that. That is what is meant by chemical epistemology. And what is really important across all of this is the attitude and the motivation of both the teacher and the learner. It is the *attitude* and the *motivation* that we provide to our students that is really very critical. You and I know that from personal experiences that the personal interaction with the student makes a big difference. Makes a *positive* big difference. And that is what I would like to remind all of us about, as we now enjoy the great advances in instructional technology. But keep in mind that it the human interaction that is really very important and very critical.

And so I ask you, as I have done on many occasions before, to think about something I call the learners prospective. While you design your course outline, your course syllabus, your course document, you write exams, and so on, try to simulate the situation where you are on the receiving end of whatever it is that you design. Put yourself in the place of the student. Try to understand how it is what you are sending to them, might be received. That is something that I have found to be very valuable in sharpening the focus and sharpening the offerings that are made, not only students in the classroom, but also to students outside the classroom. This is something that is very very imprint. To develop a feeling of whatever it is that is coming across and what the people are receiving. Not tell them what they want to hear but to be sure that you are able to communicate to them what you want them to hear. That is how the NSF budget in science education went up from 50 million dollars to over 600 million dollars. Because the audience understood and were able to act on the message that was communicated to them. I put myself in their place and tried to make sure what I was saying to them, and others were saying to them in harmony with what I was saying, was understood. So the learners prospective is something I ask you to think about.

I have already alluded to the importance of the effective use of technology. We enjoy now, in a very powerful way, a very rewarding way, great advances in technology. We are yet

to take full advantage of them. We still haven't figured out what we want to do with them and how to do it. We need to think about ways by which we enslave educational technology whether than become enslaved to it. So it serves purposes that we want to have achieved by us and by our students.

Having said all that, I'd like for you to think about the rewards of teaching. What are the rewards of teaching? I know this is a rhetorical question, but I'd like to ask it. What are some of the rewards of teaching. I'd like some responses from you. What are they? Satisfaction. What kind of satisfaction? Internal satisfaction. All right that is one. Any others. Big bucks. Yeah, right? Where do you teach? Sign me up! Not really. Think about it. What are the rewards of teaching. Please, please. Make a list for yourself, a private list if you like. And at some point, maybe make it public. It is very important to articulate what it is that we find rewarding in the very noble activity that we do. Because the people out there don't understand what it is that we do very well. They look at us as teachers. I'm going to get to that in just a second.

I can't help but flash momentarily, this transparency. For some of you who already know, this transparency, more than any thing else was responsible for the change in the NSF budgeting, the NSF budget for science education. This shows the people who are interested in science and how their interest

drops as they go up the educational ladder. But it shows more powerfully, the need to focus, not only on the people in the blue part of the display but the people out here. The whole issue of scientific literacy compared to science literacy is what this really describes. Scientific literacy, I'm not being pedantic here, scientific literacy is what those of us who are in science develop. Scientific literacy, we are the practitioners of science. Science literacy, as distinguished from that, is the sense of appreciation, the sense of understanding, that people who are not scientists develop. And that, I submit, is the very vast majority of the students that we deal with. And that is something we need to be aware of. In this connection, I'd like to pay tribute to the late Anna Harrison. Who not only chaired the 1972 Biennial Conference on Chemical Education, but later on the decade, convened conferences and really pushed the ACS and others to pursue science to the general students not just for those who are going to be majors. We need the equivalent of the committee on professional training, which does a very good job in chemistry, we need the equivalent of that, I don't know what to call it, but the committee that deals with the science understanding of the people who are outside of this blue part of the display.

And so what I'm really trying to talk about here as part of our mission, is that we need to achieve science literacy. We need to move people from a level of understanding to a level of

appreciation and eventually to fulfillment if you go back to what I said initially to what I said about the purpose of education. Achieving science literacy is a very important goal. It goes beyond achieving scientific literacy. That's what we're really after. If you believe, as I do, that science for ALL students is an important activity, is an important part of their life, then you join forces with those of us who are interested in achieving science literacy in addition to achieving scientific literacy.

Now, I'd like to ask, how many of you have seen this publication which just came out. Science and Engineering Indicators, 2000. I can't see you too well, just wave. Okay, I see less than a dozen. Look if you're interested in communicating science, you need to understand what the level of understanding of science is in the country. Science and Engineering Indicators is a publication of the National Science Board and on the 50th Anniversary of the NSF, which is this year, they put out this publication which is also available on the web. It has a lot of "interesting" information about the level of understanding that the public at large has. Here is a sample. Public understanding of scientific terms and concepts. Okay. Understands the term molecule, about 12 percent. Understands the term DNA about 29 percent. Knows laser do not work by focusing sound waves, 43 percent. Electrons are smaller than atoms, about 45 percent. The earth goes around the sun once a year. How many people do you think know that? Less than 50 percent. Earliest humans did

not live at the time of the dinosaurs. That's over 50 percent. Knows that all radioactivity is not man made, about 70 percent. Light travels faster than sound, about 72 percents. The continents are moving slowly on the face of the earthy. That's about 80 percent. Why aren't these numbers all in the high 90's. Are the people who are participating in these surveys any less intelligent than we are? I don't believe that. The level of science literacy in this country is not as high as it can be because of *us*. We the teachers. We are the custodian of knowledge in these areas. We have to communicate, not only the facts and the phenomena, but the attitudes that we have toward lifelong learning. And these are just examples of what we are up against.

You know today a school board election is taking place some place in the country, where? In Kansas. In the state of Kansas. Imagine a school board election is getting national coverage on the front page of the New York Times and other newspapers and magazines. Why is that? Because of evolution. Do you talk about evolution in any of the chemistry courses that you deal with? I want you to think about that. Why do I want you to think about that? Because I want you to think about the National Science Standards. The National Science Standards and the ACS are really trying to get a focus on the chemistry part of those standards. A very imprint document. It's unheard of in the history of education in this country to have National Science

Education Standards. Now I want to say right off the bat about these standards. To me they represent the minimal threshold level of achievement. They are not everything. That's what everyone should know, what these standards talk about. That's why I urge you to look at them, to examine them to see how you can communicate their value to other teachers and to other people in the community that you belong to.

Now I said I want to say something about salaries and so on. Here is the latest display, this is also from Science and Engineering Indicators. In the year 2000 there are about 2.7 million K-12 teachers. About 1.5 at the elementary level, and 1.1 at the secondary level. And the projects go up to about 2.766 in the next nine years or so. The number of teachers as indicated here and the needs are projected. Where are these teachers going to come from? Well some of them are going to come from overseas. And that's okay with me. That's how I came to this country. I came as a student, not as a teacher. This is a land of wonderful opportunities. I'm very grateful for these opportunities. My family and I are eternally grateful for what we have experienced in this country. But we are puzzled. We're puzzled about why so many other people who are born in this country do not go into teaching. Or they do not develop a sense of appreciation of science. Why they don't become literate in science. We need to think about the sources from which qualified teachers come. One factor has to do with the

compensation we provide teachers. Here is the average teacher salary in 1998-99 rank by the American Federation of Teachers. This is the number of teachers and this is the average salary. It ranges \$51,000 all the way down to \$29,000. There are 2.7 million the average salary is \$40,000. In the privacy of this group here, teaching is a risk of becoming a blue-color profession in this country. How can we tolerate that? How can we as individuals and groups tolerate giving that kind of compensation for teachers? Teachers who are privileged. Just to point out to you, the year before was \$39,000. This is an increase of about three percent in one year.

Teachers are asked to do a lot of different things. I'd like to quote, Lee Mareck, he's in the audience, in 1995 he wrote, "Twenty years ago I was teaching alone in my classroom, the football coach was on the field alone with his team. Now, he has an offensive line coach, receiver coach, trainer, athletic director, with a secretary and an assistant director. I'm still alone in my science classroom, but now I need to know computers, and laser disc technology, know how to write across the curriculum, teach thinking skills and math skills. Worry about safety and disposal, like I never have before, facilitate cooperative learning, and handle mainstreaming." Yes, those are some of the things that we expect teachers to do, but what support do we give them? What support does society provide for quality teaching? I'd like to ask you to think about the issues that we

should relate and communicate to our community so that we receive the recognition and we receive the empowerment to do what it is we need to do.

I mentioned, rather you mentioned something, when I asked you about Kansas. How many of you have seen this booklet, "Teaching About Evolution and the Nature of Science" that was published by the National Academy of Science? About 12, is what I see. Please, if you care about the quality of chemistry education, and I know you do, please look at what others are saying about the environment in which chemistry education is to take place. Take a look at the issues that we face in our society. I submit to you that the important issues that we have to deal with in the next ten years, are not only chemical in nature, these are important issues. Chemistry has been very successful. So successful it really a part of everyday life now. But there are other issues that are based on chemistry that relate to chemistry, that has something to do with chemistry that we need to pay attention to. What are some of these issues? One is creationism. Why? Because it reflects an attitude on the part of people. I want to say, out loud, that we in the scientific community have not been sufficiently respectful of other people views. That's what causes a great deal of the problem we need an open discourse about what creationism is. We need to have a discussion about evolution and what evolution is. So we can understand how the chemical elements

got formed. You can make a lot of links to chemistry. You can *really* focus, in a very sharp way, about issues that face our society, that we should not just say, I'm just a chemistry teacher, I don't want to deal with this. I don't want to deal with it. We should deal with it.

Another big issue is AIDS. The solution to AIDS is chemical, right? Isn't it. Drugs and so on. Do you know how many people in this country die of AIDS every year? How many? About 900 thousand. You do you know how many people died in Africa last year of AIDS? Eighteen million people! How can we, as individuals and groups, tolerate that? What can we do to alleviate that? How can we promote research so that issues like this are attended to?

Another big issue is drugs and alcoholism. They are chemicals. Don't tell me they are not related to chemicals. I'd like you to think about that as you think about what it is you're going to do in the next ten years as you teach.

We need to deal with the issues of standards, as I mentioned, already. And how we can make the standards a driving force, a successful driving force, for true reform in education. Look, I don't agree with everything that is in the standards. But, they are the only thing that we've got. So, we

have to shape them, modify them, use them, to serve our purposes. And we need to deal with the supply of teachers, both at the k-12 level and also at the undergraduate level.

We live now in an age where ignorance is cultivated. How can we tolerate that? We know much more now than ever has been known about science and other things too. But, yet we belong to a culture that cultivates ignorance. And we, as teachers, have the noble duties of enlightening people. We need to combat cultivated interest.

So let me focus now, for the next few short moments on the three traditional activities that a faculty member does. I'm taking now, about college faculty. They do teaching, research and service. You might think, that I would think, that teaching is the most important part that we do on this list of three things. It isn't. *This* is the most important one. Service. Teaching is a subset of service. Again we can discuss if you like, at some length. But these are three traditional areas. Teaching, research and service and faculty are judged and recognized by the research that they do at research institutions.

I'd like to encourage you to think about ways that we can communicate the value that we have in what we do as teachers, as researchers, and public servants. So one big attempt that is

taking place nowadays is the integration of research and education. That's at institutions that have research activities. What I like to call crossing the divide between research and education. It's as if these two activities are not only orthogonal to each other but are opposed to each other. Now I realize when speaking about research and education, I'm limiting myself to only those institutions that have research activities. There are 3500 colleges and universities in the country and most of them do not carry out research. I feel very strongly about having the quality of teaching be high at *all* institutions. But let me focus for a moment on the research institutions. What are some descriptions. Doctoral programs typically over emphasize research and under emphasize teaching and service. Gerry Graf said this about two years ago. He is the Vice President of the AACU. Now there is a movement that is promoting the scholarship of teaching. I'd like to borrow for a moment from the writings of Lee Schulman the President of the Carnegie Foundation for the Advancement of Science. He says, "The scholarship is public, it is susceptible to critical review and evaluation"

NOTE: Missing words do to tape turning

And it's accessible for exchange and use by the community. And I'd like to suggest very strongly that we think about these characteristics as we think about promoting the scholarship of

teaching. Teaching is an important scholarly activity. At all institutions, not only the so called research institutions.

My quote from Bryan says that, "In our current prevailing inaccurate definition of scholarship. Research is used as a currency among individuals within departments, between departments, within colleges, between colleges and schools, within universities, even between universities, to determine benefits and define status. Better space, bigger budget, more positions." We need to learn about the environment that we are in and what we are up against. I'd like to make a suggestion for those of you who are at research universities, where Ph.D. degrees are granted. My suggestion is twofold. One is to be sure that the Ph.D. thesis include a chapter on some educational experiment that the graduate student participated in at the K-21 level. Or some activity that he or she participated in at some museum or science center or something that they had worked with in the public media. Or anything else that the did that is educational in nature. I also would like to have a chapter explaining the research to family members, friends, civic groups, newspaper reporters, state legislators, members of congress. If you care about the communication of science, you can do something about it. Something constructive about it, by insisting the students that you send to college, the students you send to graduate school, engage in activities like this. Of course, that requires the consent of the major professor or research

director. That is not an easy thing to deal with. But if it bubbles up from below, there is a chance that it might happen.

Let me try to bring this to close, by sharing with you a couple of words. Well, more than a couple. I believe that everything we do we have to do with, I was going to say full integrity, but there is no such thing. We have to do with integrity. Because there is no such thing as half integrity. We have to be responsible in what we do. We have to take responsibility for what we do. Not saying out loud, "I take responsibility for my actions." As, someone said, you know who that is, right? Hey, he was a member of my advisory committee when he was the Governor of Arkansas. He was very very helpful. But we need to take responsibility. We need to make sure that our students and others in our community, know what these words mean and how to act accordingly. We need to make sure that we have trust among each other. Look, why do the parents send their kids to school? Because they trust us. They trust that we are going to do a good job. Not a lousy job. They trust us, they expect us to do a good job. And as such we have to be accountable. I'd like to add a third word to this. Respect. That we show respect to each other. And you know something? You can't show respect to someone else, unless you have self respect. So you show that self respect that you have to others. Because we belong and we want to be part of a community. This community that we belong to demands loyalty. You know what?

Professors now are loyal not to their disciplines, they're loyal to their subspecialties. Institutional loyalty is what I'm talking about.

We have professorial duties. To profess. That's where the word professor comes from. To profess. We need professors to profess for all of us. This can also be changed to professional duties. We need to have institutional commitment for what we do in our institutions. We need leadership. Not just managers and presidents and chancellors of institutions of higher education. We need leaders. Name a president of an educational institution right now. Name any president. Who comes to mind? The president of your institution. I'm talking about the writings and the leadership that comes from higher education. You don't have to go back to James B. Conan everybody would name that. We need good leadership. And we need to be concerned about the behavior that we have in our classrooms and outside the classrooms. We need to be concerned about the behavior. Here is an example of what I'm talking about.

A former head of Virginia Research Center indicted for misusing state funds. Why is that? Well, he made a mistake. We all make mistakes. But that does not help us as individuals and groups concerned with helping individuals achieve their human potential. We need to be aware of the difference

between a rightful act and an a wrongful act. You know the difference between right and wrong is a line. It's a thin line. It's about a half a centimeter wide. But, you know what, nowadays it's five meters wide. Anything goes. How can we, as teachers, tolerate that. I'm going to give you an example, a very hurtful example to illustrate this point, not just from higher education, but, from my own community.

In September of 1997, the Madison school teachers were engaged in a very bitter dispute with the school board about their salaries. Now, in Wisconsin, public employees are not allowed to go on strike. So on September 5, 1997, do you know what the teachers did? They called in sick. I know they weren't sick, they know they weren't sick, every person in the community knows they weren't sick. You know something, they were sick all right, because they violated a trust. They taught everybody in the community that is okay to lie. Now, I'm the last person to bash teachers. This is not about bashing teachers. This is about the expectations that we have for ourselves. I know that policemen do it. It's called blue flu. Right? Nurses do it, other professionals do it. But for goodness sake, these are teachers. The next time somebody comes up and says, "Sir, I can't take your exam because I'm sick", I don't know whether to believe this person or not because the element trusts the element of accountability were deeply shaken. And of course, the school board docked their pay. They docked their pay for

one day and then the dispute was settled and they went back to school. What did they do? They did not want to violate the state law by going on strike, but they did something worse. I have worked in my community for 30 years. And it hurts me a great deal to say this to you, as I have said it to the teachers in Madison too.

We've come to the close here. I'll let you read this. Can't see it. "The essence of lying is in deception, not in words. A lie may be told by silence, by equivocation, by the accent on a syllable, by a glance of the eyes attaching a peculiar significance to a sentence. And all these kinds of lies are worse by many degrees than a lie plainly worded". - John Ruskin, 1872

More recently, Somerset Maugham. Hypocrisy is the most difficult and nerve wrecking vice that any man can pursue. It needs an unceasing vigilance and a rare detachment of spirit. It cannot, like adultery or gluttony, be practiced at spare moments. It's a whole time job."

All right. What are the desirable qualifications of a faculty member? The first is integrity of character. This is Dean of Letters and Science at the University of Wisconsin, 1949. The first is integrity of character, the second is scholarship. Both

must be present if the faculty member is to be useful to the university. Other qualities will enhance that usefulness.

More recently, - "Faculty, all teachers, owe it to themselves to teach what they love. In so doing, they nourish their students. They owe it to themselves to show their students who they are. To do this, they need to know what they love and who they are. Not a simple task, but surely the anchor without which they will drift. " Diane Chapman Walsh, the President of Wellesly College. She goes on to say, "Great Professors", I say great teachers too, "are the ones who weave webs of life affirming connection for their students". Proficiently with technology, tightly framed learning outcomes, even multicultural awareness, are secondary to the passion professors," I say teachers, "bring to their subject matter, the compassion, awe and joy, they embody in communicating. Great teaching comes from spirit, not from technique."

Thank you very much.