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## Exhortations for Good Teaching.

Thank you for inviting me to give this talk. I plan to say some things to you that I feel very strongly about. By the way this is a quotation that showed up in the Bulletin of American Association of University Professors way back in 1973 and I hardly can give a talk without using it. So you be the judges as to whether this is true or not:

This thing here; is anybody interested in what this thing does? Anybody notice what it was doing before? You know about this, right? What is it? Anyone? It turns smoothly in one direction but not in the other direction. It turns smoothly in this direction and it slows down and comes to a rest. When I spin it in the other direction it doesn't want to go. Why is that? This is a replica of some stones that were found in an old place in England. What is it called? Stonehedge?

There is a very interesting article about this in Scientific American, again in the 1970s. This is actually a polymer, and the logo on it says, "Tun onto Science." And if you examine it carefully when I pass it around, I'd like to get it back though, you will see some properties of it as well.

So, I'd like to tell you about some things that I feel strongly about, you will not make a mistake about that, for sure. And this is a different talk than the one we had last night. Although, I want to say something about last night's talk. Specifically, I want to say that I made a mistake last night. I made an error. And I want those of you who were there last night, to know exactly what that error was. I said, when I was trying to describe the flow of wax into the wick of the candle, that

it is related to what happens in the plant. And what happens in the plant is capillary action, that's what it is. And the reason it slipped out as osmosis is, you know when I woke up in the middle of the night and I said to myself, did I really say osmosis? And I know I did, and that is because, I am engaged in so many discussion about whether it is osmosis or capillary action, and the rush that I was having last night caused the answer to come out the wrong way. So, I want to apologize to you who were there, and of course you knew all along that it was capillary action, right?

In any case, if you haven't caught my web site, I'd like to invite you to look at my web site. For a variety of purposes that will come clear to you, if you do take the time to check it out, and I'd like for you to check it out. I do urge you to read the statement that I have at the beginning of my web site. It says, "A word to the wise". I would assume that anyone who comes to my web site is wise, therefore, I urge you to read that statement.

I want to say a few things about teaching, about education. But, I'd also like to recognize a person in this department who was recently recognized as being an outstanding teacher by the Chemical Manufacturers Association. Is that you, Professor \_\_\_\_\_? There are fewer than a half a dozen people across the country that get recognized this way and this is a very special recognition. And I want you to know that this award is a charge to you to maintain what you are doing.

I'd like to borrow from Freeman Dyson's writing. One of the insulting things that speakers do is put up a slide or transparency and proceed to read it. Insulting to the audience because of course we all read at our own speed and we have various conclusions that we come to. Please take a look at that.

The way to attract young people into science is to show them all six faces. And give them freedom, a very precious word to us, in this country. So precious that so many of us don't appreciate it because we take it for granted. We give them freedom to explore the beautiful and ugly as they please. It goes on to say, in 1997, in a different publication, a failure of science, now, I'm going to read this because I want to put proper emphasis on the kinds of things that I want you to pay close attention to. "A failure of science to produce benefits for the poor in recent decades is due to two factors working in combination; the pure scientist have become more detached from the mundane needs of humanity, and the applied scientists have become more attached to the Almighty God, immediate profitability." So, I put these up so that you can all have a context for the remark that I am about to make. These are powerful statements that make us think about what it is that we do.

And I'd like to state very clearly now, that it is very important to us, in every human endeavor that we do, that we have clarity of purpose. Not unity of purpose, necessarily but clarity of purpose. Unity of purpose might be important in certain endeavors but clarity of purpose. What are the purposes for which we have institutions of higher education, or graduate institutions, or pre-college institutions? What are those purposes? Now, I'd like to share with you, in headline form, what I consider to be the purposes for the kinds of purposes that you and I engage in.

To begin, I'd like to say what the purpose of education is; not training, but education. I have selected my words carefully. The purpose of education is, I'm reading this again, is to enable individuals to fulfill their human potential. It sounds like a church teaching of some sort, and that's okay. The purpose of education, to

me, is to enable, not to guarantee, but to enable individuals to fulfill their human potential. Again there is lots of room to discuss what this means and what is beneath it.

I'm going quickly to go to what is the purpose of research, because we all do research. The purpose of research, simply stated, is to advance knowledge. We spend a lot of human capital advancing knowledge. Why? We're curious about the world that we live in. We seek answers to questions that we perceive, and we know, not just perceive, are important questions. We do research to advance knowledge.

We have colleagues who participate in doing activities that relate to the results of some of the research that we do, and they are in technology. What is the purpose of technology? What is the purpose of technology? I'm going to show you what I think the answer is, but, I'd like you to think about it for a moment. What is the purpose of technology? It is to advance the human condition. How many technologists do you know? Not many. And it is part of our responsibility as members of an educational institution, not only to state our views, but to invite others to participate in discussions about these views and to validate those views or even to discard them as need to.

Now, I'd like to take a few moments to focus your attention on the kinds of activities that we do in teaching. I'm going to talk about values, make no mistake about it. I'm going to talk about the value systems that we have as individuals and as institutions. You know people ask me very often, they say, "Dr. Shakhashiri, what business are you in"? What would you say if someone asked you what business are you in? Education. You would say education. You are in the business

of education. You know what I say? In addition to that? I say, I'm in the talent development business. That's the business that I am in. That's because I am in education and some people ask, "Well, is it for profit business or is it a non-profit business"? What would you say to that? I say this is a for profit business. Because the entire enterprise, the entire society will profit from what we do. So, we kind of define profit in a slightly different way that was suggested.

What I'd like to do now is to share with you as I focus not only on education, but a sub-set of education than we teach it. This is the title of my talk, Exhortations for Good Teaching. So, I'd like to share with you, what I consider to be the four characteristics of good teachers. In my book, good teachers have four important characteristics that distinguish them from all other teachers. I want to talk about good teachers. I don't want to talk about excellent teachers, I don't want to talk about poor teachers, just good teachers.

The first characteristic of good teachers is that they are competent in the subject that they teach. People say to me, "Bassam, this is such an obvious characteristic". Why do you include it? Why do you bother to include it?" Because it is not sufficient to hold a degree, in our case, in chemistry, or, science, whether bachelors, masters, Ph.D., to be competent in the subject matter. It is not even sufficient to be a tenured full professor at Cornell or Wisconsin or an other institution. What we have to do is maintain our competence. That is the important characteristic that we talk about. And how do we do this? We do this by advancing knowledge. What is another name for that in my book? Research. That's why we do research. And you know what? Doing research is hard work. It is frustrating.

Because the fun I am talking about is fun in the true sense of the word. I'm not talking about cheap thrills. I am not talking about getting bombed with alcohol or drugs or anything like that. You know, the brain seeks pleasure, and we have to learn to deal with that and how do we define what we mean by pleasure. So we're not talking, in research, about instant gratification. In education we're not talking about instant gratification. So, good teachers, in my book, are competent in the subject matters that they teach.

The second characteristic of good teachers is that they are committed to their discipline and to the profession of teaching. You and I know a lot of competent people in research that are not good teachers. That's because they don't have the second commitment that I am talking about. Commitment to the profession of teaching. You'll notice that I said the profession of teaching, not the profession of education. Teaching is a subset that takes place in an institution.

The third characteristic of good teachers is that they are comfortable with techniques and the methods that they use. This notion of comfort is important to me and that is why I put it here. By this I mean if we adopt or adapt a new system to our battery of methods and we find ourselves not very comfortable with it, we should abandon that method and not use it. Whether it is the use of the overhead projector or the use of the computer base instruction or the use of close circuit TV or the web or anything of that sort. We should be comfortable with it and as long as we are comfortable with it then it will be effective for us. I'd like to caution you, the difference between being comfortable and being complacent is a very very small

difference. We need to be aware that we can become complacent in terms of the activities that we do.

The fourth characteristic is that good teachers are compassionate with their students and parenthetically speaking with their colleagues. This notion, this fourth characteristic is important to me too. They are all important to me. I put them up here so that we can all think about them and discuss them. For a long time this fourth one was phrased differently. I used to talk about having passion for students. But some people misunderstood when I said that. But you know what? That's what I really mean. The caring that we have for the students and the colleagues and for the institution that we belong is an important characteristic for good teachers.

Teaching is done that the mean score will be eighty plus twelve minus three. This is a very non-normal distribution so that we really have a good cadre of good teachers across the nation, across the country and eventually around the globe, that participate in meaningful activities that relate to our enterprise.

So, I want to talk for a moment about what teachers do. We do lots of things. We set expectations, not only for the students but also for ourselves. Every time I talk about something here, it's not only for the students but for ourselves. We set expectations. We state accomplishment levels. I want you to know that in going through this list with you, I recognize that not every teacher does this. So, I am trying to be suggestive about what teachers should consider doing.

We also monitor progress. We give exams. We grade lab work and we reward achievement. Those are some of the kinds of things that we do. And you know what we should do those things for ourselves too. We should set those

expectations for ourselves. We should state accomplishment levels for ourselves. We should monitor our progress and we should seek peers too monitor the progress we are making. And we want rewards for our achievements. Now we need to decide what those rewards are and we need to negotiate those rewards with the rest of the people in our community.

So, let me just expand for a moment about the activities that those of us in teaching engage in. We seek desirable outcomes. When a student enrolls at Cornell University you go through a lot of effort to select those students. And you bring them here for certain purposes. You go through a process. And at the end of the process, when they get their degree, I'm sure you would like to think that your presence in your environment has made a difference to them. And that there are discernable differences in their characteristics and in their attributes that have developed as a result of being in your presence. If you don't believe that, then you are, in my book, somewhat disingenuous, to put it nicely, about the reasons why you engage the students to come here. So, we need to decide what the desirable outcomes are. What does it mean to be a holder of a bachelors degree from Cornell University or the University of Wisconsin – Madison, or any other institution? What does it mean? It means that the students have fulfilled their requirements as stated in the catalogue. In fact, that's what the president says at commencement. By the authority invested in me by the Board of Trustees and the recommendation of the faculty, I hereby grant you or anoint you, or whatever it is, what is it? Confer. Confer on you with all the rights...



Those statements means something and what I am asking you to think about is what is meant by those statements. What happens in the four years? I assume it takes four years to get a degree here. What transformation happens? That's what I am asking you to think about in terms of the desirable outcome, as for setting expectations, as I have already mentioned. What are the expectations? You can do this on an institution basis. You can do this on a departmental basis. You can do this on the course basis. I do it on a course basis because I want to see for myself and tell my students what the desirable outcome is and what my expectations are. And I will tell you about one such desirable outcome that I have for my 350 students who take first year chemistry with me, first and second semester. And this is what I say to them. If I see you one the street after the course is over and ask you a question about something that was in the newspaper, in the Tuesday, New York Times Science Section or any other paper that had something about science. If I see you and a friend on the street and I ask you a question about that, I want to be able to tell, by the way you field my question, which one of you took my course and which one of you didn't. That's a pretty tough criteria for you to set for yourself. At least I think so. But that is the criteria I set for myself. Oh, not that they spit out

\_\_\_\_\_ and this other stuff and give me the \_\_\_\_\_ equation.

No, I am interested in the way in which they field the question. That is what I am interested in. So, that's a desirable outcome that I seek. That's an expectation.

We develop strategies for achieving those expectations. Professors are very good at developing strategies. Very good at developing ways to accomplish certain

goals. What they are not very good at is stating what those goals are. That is why I begin by asking what is the desirable outcome? Students say the desirable outcome is that they pass the course. That is not what they are really saying. They say get an A in the course. We look at the attributes as I stated, we need to look at discernable changes in the students attributes as they, forgive me, are processed through our courses. We need to look at their achievements and we need to attach meaning to those achievements. Here is an important point that we really need to think about. What are the consequences of success in terms of what we are trying to do and how do we do it? And what are the consequences of failure? Something that we don't pay enough attention to. What are the consequences of failure in terms of what we have set up in our institutional offerings, so that when a person gets a degree from Cornell, people can tell that that person went to Cornell and not some other institution. That is what I mean by looking at the attributes. Can people tell that? You might not agree with this preface that I am going through. You might not agree with this. But I told you at the beginning these are the kinds of things I feel strongly about and I am sharing them with you.

We encourage students to move along. And do you know what? We need encouragement. Faculty do not get sufficient encouragement, either from the Department Chair, or from the Dean, or from the professional societies. Faculty need to be stroked. Faculty need discussions with their peers to appreciate the values of what they are doing or what they are trying to do and more importantly to make adjustments in those kinds of things.

And that brings me to the rewards. What are the rewards of good teachers? I know it sounds like a rhetorical question, but it isn't. I have asked a lot of rhetorical questions here today. I want to ask you this. What are the rewards of good teachers? Are there any? This is a group of people who care about teaching, and who pride themselves on high quality teaching. I can testify to that. Suppose I ask you, what are the rewards for doing good research? I wouldn't be able to shut you up in terms of listening to the answer and all the things you'd have to enumerate. But if I ask what are the rewards for good teaching, there might be some pausing. So, I ask the question now, rhetorically. I'm trying to be suggestive that there are things. These are the kinds of things to be thinking about and there are other kinds of things as well.

One thing that we do in teaching chemistry, if I can focus on that for a second, is that I believe that we are engaged in a hierarchy of activities. The first level of this hierarchy is what I call learning chemical facts and phenomena. And as the word hierarchy implies, everything that shows up higher than what is already shown will indicate that.

So, the second thing that shows up on this hierarchy is what I call chemical models and theories. A lot of people like to start with chemical models and theories then use facts and models to illustrate. That is a little different way of doing it, but I'm sharing with you the way that I favor it. What else do we do? We develop chemical skills. Chemical skills are at least two varieties. Laboratory skills \_\_\_\_\_ also mental skills.

How to approach problems. Is it worthwhile to spend two and a half hours on this one problem? Not the problem set, the problem, this one problem. So we develop these kinds of skills as we teach and learn chemistry.

The fourth level is chemical epistemology. That is just a fancy word that means what? How do we know what we know? How do you know that the formula for sodium chloride is NaCl? Because it says so in the book. Right? Or the teacher says so. Where did the author of the book get that information from? Well, he or she read it in some paper. How did the author of the paper find out that information? Why is isn't it NaCl<sub>2</sub> or whatever? Okay what I'm talking about here is the fundamental basis of knowledge. That is what we do in research. We ask that question. We ask it so routinely that when we get to teaching we forget about it. We forget about the way it should be used with open minds. Now across all this in my hierarchy, and I have no easy way to display this, except to put it on top, is the attitude and motivation of the teacher. Now, I want to say something about the lecture method of teaching in this college \_\_\_\_\_ . Because it come under attack from a variety of sources. I am not in defense of the lecture method but I want to tell you the most important function of the lecture method of teaching. And that is for the lecturer to convey his or her attitude about the subject matter for which they are teaching. It's not just to learn the facts, it not just to know

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Or how to manipulate mathematical equations (A lot of coughing \_\_\_\_\_) It is for the attitude, for conveying an attitude about the subject matter that we teach. And also

to provide motivation, so call inspiration as well. So these are some strong feelings that I have and I want to share with you.

I would like you, one more time, to think about this, I don't want to leave this. We don't do it for the money, do we? We are so, not only capable, we are able to secure other jobs, with much higher pay, outside of academia. Yet we choose academic life for a reason. Because those are rewards, not only for teaching, but there are other rewards that we get as faculty. I'd like you to think about that and share your ideas with me.

Now, I want to say something about what I call the effective use of technology. We are all enamored, well, most of are, with technology in education. The web being the latest, before that it was computer based instruction, before that it was closed circuit TV. We have tried, and have spent so many different amounts of money and effort trying to use technology to help us in our teaching. For the most part, I believe, the intents have not been successful. For one thing they are billed as being the solution to all the problems we have in education, and they are not. So I ask that we think about the effective use of technology not just the use of technology. Nowadays the fad is that you take any piece of information that we have and we digitize it. That is what the fad is. I am not making this up. But, what do we do with that information once we digitize it? You put it on the web. You sit and watch it. How many lines do you have on the screen now? Depends on the quality of the monitor. What do you learn? You may learn some facts. You may visit some web sites that have information on them that you would have never have ad accessed before. Remember I talked earlier about the clarity of purpose? What

is the purpose of sitting at a computer terminal five or six hours at a time, just going from one web site to another? What is the purpose of doing that? You might as well watch MTV. You probably do anyway, but, what is the purpose of that? Cheap thrill? I told you my talk is about values. I am not shy about telling you what my values are. And I welcome your disagreement.

I'd like to call you attention to this. An effort was launched by the Carnegie Foundation. A report called "Ready to Learn, A Mandate for the Nation." Ernie Boyer wrote it. Did I tell you about the old joke about Clark Gable, when someone says, "Oh, he must have made that movie before he died". Ernie Boyer wrote this before he died. It is a very good report that focuses attention on getting the nation ready to learn. Those of us that are engaged in highly sub-specialized areas of research, don't have the time to read something like this. We might be interested in it because of the nature of what we do in our research requires that we be sharply focused. You know in order to excel you have to be sharply focused. If your not sharply focused you are not going to excel. But someone in the community that we belong to should pay attention to these kinds of things as the rest of us are sharply focused on the research that we do. We should do it because we need to consider another report that Boyer wrote called, "Scholarship Reconsidered". We define scholarship as, "the operational definition of scholarly work in research". I'd like to suggest to you, as Boyer has suggested, that we need to reconsider that operational definition and think about the kinds of activities that we do in teaching as being scholarly too. And we have to define what scholar of teaching really refers to. So this is another report that is of great interest, or should be of great interest but it isn't

as yet. The Boyer Commission then later on, just a year and a half ago, wrote a report reinventing undergraduate education, "A Blueprint For America's Research Universities". You know the salvation is not going to come from University of Wisconsin – Superior or the University of Wisconsin – Whitewater or the University of Wisconsin – Oshkosh. The salvation of the Research University enterprise is going to come from the University of Wisconsin – Madison. Why is that? Because that is where the richness of talent resides. And the richness of talent resides, for now and the other research universities should devote part of its time to deal with important education issues. The payoff is not immediate. In research the payoff is not immediate. We don't get immediate gratification when we do research. The payoff in these kinds of activities that I'm talking about is even longer term than it is in research. But it behooves those of us who care so dearly about research, about advancing knowledge, to keep in mind the context in which we carry out these activities. And that is why the research universities have a very critical role. The research universities have a critical role in defining what undergraduate education is. I daresay that what goes on at graduate level now is not education. It is called graduate training. I'm trying to be controversial about it, Okay? I am trying to get you to think about this so you can discuss this after I leave. You can even send me an email about it. You can even, you know, five years down the line, you can think about this and say, "Hey, that guy, Shakhshiri, we was wrong about it because I am doing, this and that". Or you can say, "He was full of it, too". It is a free country, you can do what you like. But, I am trying to

engage you into thinking about important intellectual points that are vital to the survival of the enterprise that we care so deeply about, namely research.

Now, I would like to suggest, if you haven't done this, to look at the Science and Engineering Indicators. Here is the web site. Just out of curiosity, how many are willing to admit that they have looked at this? How many have? One, Two.

This is a publication from the National Science Foundation. You know

\_\_\_\_\_ at the NSF works for the National Science Board. Cornell has had very good people appointed to the National Science Board. And this is one important report they issue. I suggest that if you are interested in the research enterprise and the education enterprise you look at the Science and Engineering Indicators and find out such interesting information as the following: What is the level of funding that goes into chemistry? What is the level of funding that goes into physics? What is the level of funding that goes into mathematics? Not just at the NSF, but elsewhere. And what about the status of science literacy, as distinguished from scientific literacy? Scientific literacy is what you and I, the practitioners of science, acquire and appreciate. Science literacy is the level of appreciation,, the level of understanding that the non-scientist develop as they learn about science. Do you know what the reports say, they say, among other things, that fifty percent of Americans, adult Americans, you know this because I here you chuckling, fifty percent of adult Americans don't know how many days it takes the earth to revolve around the sun. You shaking your head. And a comparable percentage, actually, it is not comparable, twenty percent of adult Americans believe the sun revolves around the earth. Twenty percent. Let's see what is the population



of the earth? Twenty percent of 250 million right? Twenty percent of that is what five million, (fifty million)? That's more than the entire population of Wisconsin that believe that the sun revolves around the earth. Now, it wasn't all that long ago that what's his name was put to death because he said that it was otherwise. What was his name? And the person before him? You see we are the custodians of knowledge in this area and it behooves us to share this knowledge with others. So that, I don't know what the right percentage of ignorant people should be. But I do feel that it should not be twenty percent.

Now, what is that important? You know, does it really matter to the average person on the street, that it is the other way around? Does it really? Not really. What does it measure? It is a measure of our values as a society when we allow a segment of our population to remain ignorant of the wealth of knowledge that we have. That is what is wrong with it. There are other interesting pieces of information.

I mentioned earlier about the importance of the interaction with peers and I would like to call your attention to activity that we do at Madison. It is called Peer Review of Teaching. It is a very non-threatening activity. By inviting people to participate in testing each other, discussing with each other all the different activities. All this information is available on this web site ([www.wisc.edu/mool/](http://www.wisc.edu/mool/)). This truly, so far, working. Not because it is mandated by the administration but because some faculty members like to do it. I had a faculty member, from the School of Medicine come to my class. He brought a video recorder with him. He videotaped my class. He looked at my syllabus. He looked at my exams. He sat

down and reviewed that videotape once, twice, three, four times. Until he stopped seeing new things that he hadn't seen before in terms of what I was trying to do. Not asking \_\_\_\_\_ but as a person who was trying to teach. And then he sat down with me and \_\_\_\_\_ me with that critical review. And he and I sat and watched the video together.

That is one way to do this, not the only way to do it. A lot of people are threatened by doing this. I happen to be comfortable in front of a television camera. So this is once again referring to the comfort that we were talking about. So it was okay for me to do this. But there is a portfolio that developed. Those people who care about peer review \_\_\_\_\_. And we do care about peer review. Isn't that how research enterprise divides the funds. That is how we do it right? We have panels, all parts of the National Science Foundation and the National Institute of Health and Department of Energy and the Department of Defense and Department of Welfare. We all do this right? So why not seek information from our peers?

What I would like to do now, in the remaining part that is available to me, is to share with you about some very deep concerns about what it is that we, as individuals, and as a community are concerned with. So, I am going to talk about some issues that make some people uncomfortable. I don't mean to make you uncomfortable, just the opposite, I want to give you a certain level of comfort. But I believe that we have serious questions in our scientific enterprise and our academic enterprise and in our academic enterprise as well, that relate to integrity. Personal integrity as well as institutional integrity. Looking the other way when something

wrong has happened is not going to make the problem go away. In fact, it is going to make other people who see us, looking the other way, when the problem is happening, they are going to learn, hey, maybe that is the correct way to deal with it, by looking the other way. So I would like to talk to you about these two words; Integrity and Responsibility. When you take in students at Cornell, graduate students, or undergraduate students, you take on a responsibility for them, for their education. They also, should learn how to take personal responsibility for their learning. And it is part of the Cornell experience. The word responsibility, is not a word that gets \_\_\_\_\_ around a great deal nowadays, not only in Washington, but elsewhere. You know, the Presidents says, "I take responsibility for what I did". What does that mean? What? I am responsible for what I did. Not just the President, but others say that too. What does it mean?

The system works because there is an element of trust. The students, the parents, the taxpayers who support the activities that we do here. They trust us, otherwise they wouldn't send their kids here. They trust us. The National Science Foundation trusts that we'll do the research that we say we promise and we'll do it with integrity and responsibility. So we need to develop a little more accountability. Actually, this accountability should be to ourselves. That is what it should be. And if it is done properly to ourselves then it is easy to share with others. So, I'd really would like for you to think carefully about these four words here. Because they are not only important to our enterprise but they are important to the rest of our society and we are part of that society. The longer we isolate ourselves from the rest of society, the bigger the risk of the society cutting us off.

Now, I want to share with you a transparency that I used a lot when I was at the NSF. Some of you remember seeing this, not only at my talks but in the talks of others. This is a display, so called pipeline in the Science and Engineering Indicators. The persistence of interest in natural science and engineering science including mathematics in the high school through the Ph.D. Degree. This as you can see, I used this slide a lot, it is sort of worn out. But in 1977 there were 4,000 sophomores in this country. Of those 4,000 sophomores 750,000 expressed an interest in science and engineering. By the time they got to be seniors in high school the number dropped down to 590,000. And when they entered college a year later, the number dropped down to 340,000. For those of us who like to express numbers in a variety of ways, that is a forty percent drop in one year. That catches our attention differently than just looking at the absolute numbers. 206,000 received a bachelors degree, 61,000 enrolled as graduate students, 46,000 received a masters degree, 9700 received a Ph.D., fewer than 10,000 received a degree in science math and engineering.

That is the pipeline. You know the bulk of the research funding in this country, goes to support these people down here. At the very stem of the display. This display is powerful because it not only shows us these kinds of numbers, but it shows us two segments of society. There are the people who are in the blue part of the display and there are those who are in the white part of the display. The people who are in the blue part of the display are the people that I call, and others call, the people of the science rich center. And the people in the white part of the display are those in the science poor center. They are not poor people, they are science poor.

So those of us that are in the blue part of the display are the scientifically literate.

So those of in the blue part of the display should worry about the scientific literacy of the people in the white part of the display. For a lot of valid reasons, not the least of which is a crass reason. The people in the white part of the display pay for what those of us in the blue part of the display do. That is where the tax money comes from, that is where the private foundation money comes from. You don't think the scientific enterprise would survive if the only support came from the people who are scientists. You know it won't.

So it behooves us to pay attention to the quality of science understanding and science appreciation. Because I believe that what we are really engaged in is a movement that goes from what has happened inside the classrooms and outside the classrooms aimed at achieving science literacy not scientific literacy. I know that this sounds like a \_\_\_\_\_ but it isn't. Achieving literacy has to move from understand, to a level of appreciation, and eventually to fulfillment. The kinds of things I was talking about before in terms of development and fulfilling one human potential. And those of us who are in the blue part of the display have an obligation, have a responsibility, to see to it that the majority of the population develops a sense of understanding, a sense of appreciation, of what we try to do and why we do it. And in this context I like to give an analogy as I have done before. The analogy comes from sports because most of the people here can relate to that. Just as we have professional baseball players and basketball players and football players, hockey players and so on, we also have sports fans. And without those sports fans the entire professional sports enterprise would be nothing. And you know that is not

an exaggeration. But that is what we need. We need scientists and we need science fans. We need those fans to be active participants in our enterprise. We don't want them to be passive sitting in the stands watching what goes on. We don't want them to be scientists. We want them to have a sense of appreciation of what science is all about. And we want fans of true science not pseudo science. We need the fans to be able to distinguish between astronomy and astrology. We need people to learn why burning the rain forests in South America is bad for the environment. We need people to learn why is it that the Chemistry Department at Cornell University is changing it's name from the Department of Chemistry to the Department of Chemical Biology. They are not doing it for frivolous reasons, they're not being capricious about it. You know yesterday I \_\_\_\_\_. Today I put Chemical Biology. I didn't know. We need that to be explained to other people. Even other people on campus, right? It is not just people elsewhere. And who is going to do this explanation? Not the people in the white part of the display, the people in the blue part of the display. And as I said we need fans of true science, not pseudo science. We do not need professional wrestling fans. I want you to think about it. Think of the meaning of fun the way I am using it. You think about the fulfillment that we are dealing with.

So, I want to say something else about our community. We belong to a community. It is a special community. It really is special. In as such it gives us special powers that we don't exercise all the time. You know life is about lots of things, but do you know what life is really about? Again, in my opinion, life is about good judgement. That is what life is about. Life is about good judgement.

Oh, we might say, I made an error in judgement. Bologna! That is not what we did. We can discuss that point. We belong to a special community and we have an obligation.

We have a sense of loyalty. I'd like for you to think about the loyalty not only to the scientific and technological community but also the loyalty to the institution. Faculty members nowadays at Wisconsin and elsewhere, I'll speak of Wisconsin, have a different loyalty that they did when I joined the faculty in 1970. They are loyal to their profession. They are loyal to their sub-specialty. Institutional loyalty is weak. That is a threat to community. I don't know how it is at Cornell but you are not terribly different than we are. Maybe you are. I'd be happy to hear about it. We have professional duties. For God's sake the word professor means what? To profess. Are professors professing today? They have the title. It is part of what we do, to teach. You know the first thing that a person does when they get a grant? What is the first thing that they do? They buy time out of their job. Well, maybe the second. But it is among the first things that they do. It is changing, right? Startup packages for new faculty include, release time. That is what we call it at Wisconsin. What do you call it? You don't do it? This is part of your duty to explain to other people why you don't do it. That you don't do it because it is not a good thing to do. But is done elsewhere. I think it is important to provide institutional commitment. You know we do all of these things that I'm talking about, we do them because we belong and we want something back from this institution. It means something, doesn't it, to be a Cornell Faculty member? It means something. We want the institution to recognize and reward that.

We need some leadership. Right now, in academic institutions we have managers. Some of them aren't even good managers. A standard question that I ask colleagues, in private, or, I will ask it in public now, name the president of a university? Go ahead.... Name another..... If I ask you to name a president of a university you would name, Conin? Wouldn't you name people who are leaders? You ask any faculty member now that question and sometimes they give you the president of their institution and that is about it. So there is a need for academic national leadership. That is the point that I am trying to make.

The last point that I want to mention here, is really personal, as well as institutional. It has to do with behavior. Because I believe there are serious problems in the way in which institutional and individually we behave. And these problems can be easily addressed but not solved. They are addressed easily but their solution is not simple. It has to do with not telling the truth. That is what it has to do with. I am going to cite one example of this to make a point.

On the 5<sup>th</sup> of September in 1997, the school teachers in the Madison school system picked up the telephone and called in sick. There had been a dispute between the school board and the teachers. This dispute was not going anywhere and it is against the law in the state of Wisconsin to go on strike. So instead of those teachers going on strike, they picked up the phone and called in sick. They know they weren't sick. Everyone in the community knows they were not sick. They were sick alright. Because they taught every kid in the Madison school system that is okay to lie. So the school board docked their pay. They didn't get paid for that one day. That is okay. But the lesson the kids learned was that it is okay to lie.



Now you know I am not into bashing teachers. I've devoted my life and my career to promoting teaching. That action, even now still hurts. It is not just only the action that I am concerned about, but it is this to.

“The essence of lying is a 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 attacking a peculiar significance to a sentence; and all of these kinds of lies are worse and baser by many degrees than a lie plainly worded.”

Here is something that is related to it.

“Hypocrisy is the most difficult and nerve racking 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 in spare moments; it is a whole time job.”

So I come back in closing to what we as individuals, to what we as members of the community, to what we as people who care about the quality of the institutions that we belong to, academic, professional and otherwise, should be concerned with. We should really not misuse the trust that we have been given. We should always act with integrity. You know the oath that the physicians take, what is it called. The Hypocrite Oath? What does it say? Do you know what it says? First, do no harm. That is what it says. Do you know what I say? First, and always do no harm. Not just first. Not only harm to ourselves but to the community and to the institution that we belong to. And take responsibility and what that means \_\_\_\_\_ and be concerned with the consequences of it regardless of whether it is good, bad or indifferent. Be concerned with the consequences of what we are dealing with.

So, I'd like to really thank you for listening to this flow of opinions and emotions on my part. These are things that I not only thought about a lot but I've lived them. And these are the kinds of concerns that really drive what some of you saw last night. If it weren't for these concerns about the quality of our profession, the quality of our community the quality of our institutions, the quality of life in our society, then this other stuff that we did last night would just be \_\_\_\_\_ instead of being the process. And I firmly believe that true leadership will come from people that are not intellectually stimulated as we are when we do research but who find emotional rewards when we apply our intellect in solving important societal problems that go beyond achievements in \_\_\_\_\_.

Thank you very much.