ACS Meeting New York, NY
Fall 1991 Symposium
August 26, 1991

Thank you very much, Jerry, for your kind remarks. Good morning everyone, I am delighted to be again at the ACS meeting in New York City. Last time I was at the ACS meeting here was five years ago. As I said then, this is the greatest city in the world, and I am proud to be part of the symposium to be honoring Dick Ramette on the occasion of his receiving this award. So Dick, I congratulate you. I am proud of what you have done. And I congratulate the Analytical Division for exercising good judgement in selecting Dick for this award. They also selected another colleague of mine, John Wright, to receive an award this morning. It made it very difficult for me to be in two places at the same time. But I am very happy to be here and I want to tell you, Dick, that with this award, not only comes recognition from your colleagues, but comes an added responsibility. This responsibility has to do with expanding the efforts that we are all engaged in to communicate not only science but to communicate our value system as practitioners of science to the rest of society. Because, if any segment of society, no matter how small it is, and the scientific community is a small segment of the American society, no matter how small that segment of the society is, if it fails to communicate its value system to the rest of society then it risks, very quickly, losing the support of that society. So that is a practical reason for why we need to communicate our value system: what we care about; how we treat each other; how we treat our planet; how we treat the people in our own

environment. Communicate that value system, not only to the students who are in our classrooms, which is our primary responsibility as classroom teachers, but to others in our society. So, what I'd like to do is go through a series of transparencies to share with you some of the ideas that have come across lately that require an expansion of our approach to communicating science not only to future scientists but to others in our society. Now, you and I, Dick, as well as everyone else in this room, we have a finite number of heart beats left in us. We do not know what that number is, but we should be very careful in how we allocate our time, so that those heartbeats are used in a productive and effective way.

There is a great deal of discussion these days about chemistry. Here is a headline from a newspaper in Madison, called The Capital Times. When you were in Madison, you read The Capital Times. The headline article says (the article is about two months old), "Do Brewers lack proper chemistry?" I had to look at this twice to be sure they were talking about the baseball team rather than the brewers of beer. (Laughter) That same weekend, I saw another article in Sports Illustrated. Are there any here that read Sports Illustrated? Yeah. This issue, the July 8th issue, in which a former NFL star, Lyle Alzado says, this is the headline...."I lied..." talked about value systems, talked about courage to communicate our value systems. In this same issue, in the back where the editorial comments are made, the headline is "A Chemical Reaction: Do Teams Have Bad Chemistry and Good

Chemistry? A Non-scientist Explodes a Myth." He goes on to say....

> "I was never much good at chemistry. My teacher at high school was an extraordinarily disheveled codger whose white lab coat bore the tell-tale stains of too many experiments gone haywire. But, I can't really blame my almost total ignorance of the subject on this slipshod educator. No, the fact is, I mistakenly regarded chemistry as more of a game - its beakers and burners merely toys - than a serious intellectual pursuit."

A learned man regarded chemistry as a game rather than a serious intellectual pursuit. But he doesn't blame his high school teacher, nor am I here to blame his high school teacher or any other high school or college teacher. I am here to participate in saluting a great teacher whose value system has affected us all and to call upon him and upon you to have an expanded manifestation of the communication of our value system to others in our society. I know their going to spend a lot of time on one of the corners in your tetrahedron, the one that you referred to as a black hole. I also noticed that in your revised tetrahedron you put down writing as a subset of teaching. I ask you, Dick and all of us here, to seriously consider the all important task of not only teaching chemical facts and chemical principles and sharing the excitement of doing chemistry with other people, but to communicate what we really believe is important in life. You see, chemistry, the analytical sciences are but vehicles to convey our attitudes to

others about the things that we think dearly about. I really urge you to read this editorial, because it does affect us..., I hope it will affect you the way it has affected me, in terms of spurring us on to do more to reach not only the future chemistry majors, not only those that will be certified as having met the CPT requirements, but the vast majority of the students who for some reason or another, often for the wrong reason, find themselves taking a science course and find themselves taking chemistry. What can we do.....what must we do to see to it that they become literate in science whatever that means? What does it mean to be literate in science? What does it mean to be chemically literate? About eight months, two authors Hazen and Trefil, published a book called Science Matters: Achieving Science Literacy. Hazen is an earth scientist and Trefil is a physicist. Their book reflects their own biases. I have yet to see chemists participate in this growing endeavor aimed at improving the scientific literacy, not just the chemical literacy, of the population at large. Why do we need to do this? Because chemistry is all around us. Here is a display of a series of articles that showed up in the July 29th issue of U.S. News and World Report. Something was happening around June and July to bring chemistry to the forefront as much as I am trying to indicate. Actually, nothing was happening unusual, it is always in the forefront. I just happened to pick those because they are recent. "The nitrate threat: The chlorination quandary". This is a description, a fairly accurate description, of problems related to nitrates and chlorination. Some of the write-ups that accompany these displays are quantitative in nature. They go on to talk about lead

poisoning and microbial contamination. They state the problem, state some solutions. I wonder, Dick, how many of the Carleton graduates who did not take your course or take Jerry's course are able to comprehend what these stories are all about? I wonder if they are able to understand what this piece of the article is all about, "Chemical menaces"? I showed this slide to a colleague of mine and he said that this headline, in the eyes of the public at large, is redundant. Chemicals are all around us and they are very beneficial. They have potential hazards, but we, somehow, do not communicate that effectively to the students who are not chemistry majors. Where did that hydrogen come from? Does one have to take a chemistry course or a physics course to figure out where the hydrogen comes from when something goes wrong in a nuclear reactor? Another cover story, Business Week from July 29th, "The new alchemy." "Call it the materials age. By combining atoms in novel ways, scientists are creating materials that open up bold possibilities: pocket size super-computers, super-light aircraft, ridges that form when they are gleaned." Does anyone in this room doubt that chemistry is the basis of this? Oh never mind the headline about alchemy for a second or two, because that headline communicates something about the people who wrote it and their literacy in science and their literacy in chemistry. I don't need to really spend much more time on exhorting you, Dick, to communicate to the non-scientist. I don't need to spend any time with you and with my colleagues here, because when I talk to you about this and I talk to my colleagues about this topic, I always get accused of preaching to the choir. Dick, the choir isn't singing and I want the

choir to sing. And I want the choir to sing out loud and in harmony! Chemists, indeed all scientists, have yet to show up on the playing field that deals with the communication of science and our value system as scientists to the rest of society. That is the added responsibility that comes with your award. Because, as many of you know, from this chart, that a lot of people of accuse me of showing in every talk I give, all of us tend to focus on the people who are in the so-called science pipeline. This is the display of persistence of interest in the natural sciences and engineering of a population of high school sophomores which numbered four million in 1977. These days it is about the same number. It is approximately 150,000 smaller in size. Of those four million high school sophomores, 750,000 expressed an interest in science, math, and engineering. By the time they got to be seniors, the number dropped down to 590,000 and one year later when they entered Carleton College or the University of Wisconsin or Worcester College, the number dropped down to 340,000. For those of us that think quantitatively, that is a 40% drop in one year. Slightly over 200,000 received a bachelor's degree in 1984, 61,000 enrolled as graduate students, 46,000 received a master's degree, and a year from now, fewer than 10,000 will be receiving a PhD in science, math, or engineering. This is the pipeline....the CPT guidelines are for people in this blue area. Terrific guidelines. How many chemistry departments would be in existence now had it not been for the ACS leadership and the CPT leadership insisting that departments must have a minimum number of faculty members, insisting that there should be subscription to Chemical Abstracts, making sure that instrumentation is

at an adequate level, and the rest of the CPT guidelines? What I'm saying, Dick, is that now we have to pay attention to the people that are in the white area of this display. Where are the guidelines for science literacy or chemical literacy? Where are they? We are of course very busy working for my tenure, being good citizens of our colleges and universities, even some of us are foolish enough once in a while to take time off from being a university professor to go spend some time in Washington, and in the process just get beat up on but that's another story. But where are the people who have convictions about their own careers, about why they teach, not only how they teach or what they teach, but why they teach? Where are the statements coming out from professional organizations including the ACS that are non-perfunctory statements about the importance of seeing to it that the national reform movement in education benefit from the intellectual prowess of those of us who are in the scientific community. You are right. We don't want only intellectual minuets. Want to study something, learn something. Be in touch with people who care about the environment that they live in. By the way, those of us at colleges and universities, until very very recently have only paid attention to the people in this segment of the display. As you know, the sophomores are voting at this time. This is not when they develop an attitude. This is an attitude that came because of their exposure to science, to math, to intellectually activities in elementary school and middle school. That is why colleges and universities have to pay special attention to these areas. Much more so than now. We have to have fundamental, comprehensive, systemic change. Not just incremental

change. Not only changing one small thing in Dick Ramette's computer program for doing equilibrium calculations. We need that. I said, not just that. We need an overall picture that helps us look at not only the content but the staff and staffing, the identity, the qualifications, the commitment, the passion that the staff have for what they teach. We need to be concerned about the conditions for learning. That is a euphemism that covers a lot of territory including one, especially one that I want to bring out in this setting. How can we, as scientists, tolerate having courses be offered under the heading of science that don't have a laboratory component. Government, there is your tenure thing, Dick, among other things; resources: intellectual resources, people resources, financial resources; buildings, buildings across the country are deteriorating; facilities need attention. That is why we need a comprehensive fundamental systemic approach to solving these problems. And, of course, all of us are busy trying to make tenure, or to write the next grant proposal and to worry about supporting the graduate student that we now have, but we have to be concerned as I know deep down we are as to where those graduate students come from. You have had a good connection with Wisconsin, at least three of the people in this symposium are from Wisconsin. Carleton has been a good feeder of good graduate students at Wisconsin. One of my observations after having been gone from Madison for six years in Washington, the profile of the incoming graduate students is different. There are many more foreign students among the graduate student population than when I left. Of course, I have nothing against foreign students coming to this country (laughter)

and studying in this country. It is the greatest tribute that we have to our institutes of higher education that students flock from all over the world to study and pursue graduate training in science, math, and engineering but what baffles me is why aren't there native born Americans coming too who want to become scientists. Why??? Not only why, I'm baffled only in a rhetorical way, I understand what the problem is, I even understand some of the solutions. What I'm bemoaning is that we as yet do not subscribe to a national strategy, not a federal strategy, but a national strategy. So what goes on at Carleton or at Oswego or at Worcester or at Madison or in Peoria or in Terre Haute, what goes on there is part of a national effort that aims at enhancing the quality of life in the United States. That is what education is all about isn't it? I mean, if you did not believe that you could influence people, why are you in education? I was influenced by this man. The very first time.....he doesn't know this.....the very first time I was influenced by him was when I read that in 1966, when I was still a graduate student, I read that he received the CMA award. That means something! Then, I met him a few years later and I was wanting to learn more about him and what he offered. Not only did I learn more but I learned how to do some other things in a rather exocharmic way repeatedly. So we need to have some goals and some standards in this national strategy. What are some of the national goals that we can have? We need to be concerned about student achievement. I know that this sounds like a global thing, and some of you have heard me talk about this before and may be a little tired of it, but look.....you are an emeritus professor

now, so I'll shift from using you as a shell and go over to Jerry Mohrig. Jerry, what does it mean to be the holder of a bachelor's degree from Carleton college? It means that the students have fulfilled the requirements for that degree. But what does that really mean? What is beneath those requirements? How has the experience of Carleton influenced the attitude of those students beyond being able to use Dick Ramette's computer program? By the way, what does it really mean to be the holder of a bachelor's degree from the University of Wisconsin-Madison? What does that really mean? What is it that we are doing to bring about a change in those human beings who come to take courses and get training and get an education? What does that really mean? Hey, Jerry, did you produce any teachers, high school teachers, college teachers, professorial types? Hmmm? What is their value system? Is it just doing undergraduate research? Is that the battle cry? A concern about the environment for learning. Boy, I remember when I first went to Madison, 21 years ago, a colleague of mine, who is still on the faculty, said, "this a great place except for the students who get in the way come September." He was talking about undergraduate students. I can say, he, with a great deal of confidence, because we didn't have at the time any women faculty members. We have some now. We need to be concerned about the quality of the curriculum and we need to be concerned about the effectiveness of the curriculum. Is it effective in bringing about these fundamental, comprehensive, systemic changes? How do we know that it is effective? I'll tell you how I try to know. I tell my students in my Chemistry 103-104 course that at the end of one year of

taking chemistry with me, if I see you on the street, and I have over 300 students in my class I don't get to know each one of them personally, but if I see you on the street with a friend, and I ask you a question about something in the New York Times Tuesday science section or in any other newspaper, it has to do with science, if I ask both of you a question, I should be able to tell from your responses which one of you took my course and which one didn't. Hey Dick, that is a very tough criteria to set for oneself. I'm not talking about a technical question. I'm not talking about telling me the pH of a .01 M HCl solution, I'm talking about something that's in the newspaper that has to do with science. I am talking about where does the hydrogen come from which was in the newspaper. It wasn't just in a Saturday class that you have had. Well, I think we should have some national standards at each grade level, K-16. (clapping) See, we look at our task as being just teaching the people who come to us. I suggest that we should look at the entire spectrum going from K-16. I know that K-16 is education jargon and doesn't sit too well with people who do research in science, but we have to communicate with each other and with other people in the white area of that display, so we have to use language that they use and they understand until such a time that they are able to use our language. We need to set those standards, but more importantly, we need to help the students achieve those standards. It is easier to set the standards than to help the students achieve them. And so I suggest, as I have been doing for the past several years, that we look at the curriculum in three major areas: [END OF TAPE]