

Chapter 2

The Council for Chemical Research

Developing the Trust Factor

J. Ivan Legg

College of Sciences and Mathematics, Auburn University,
Auburn, AL 36849-5319

In the late seventies it was evident that we were beginning to lose our technological lead in the world economy. In an attempt to address this issue, Mac Pruitt, Research VP at Dow, convened a meeting of academic and industrial leaders from the chemical sciences and engineering community. It was clear that the vital link between the two parties was in critical need of improvement, and the Council for Chemical Research was formed. CCR has had a positive impact over the past decade. CCR's success is based on the trust that has evolved between the academic and industrial members who represent the major part of the research leadership in chemical sciences and engineering. CCR is truly unique among scientific and engineering organizations in the U.S.

Consider the following scene, a scene that will bring warm memories to some of you. It is a late Saturday afternoon. You walk into your research laboratory to find your group hard at work. A graduate student is listening intently to one of your postdocs explain the fine points of preparing a column for chromatography. Another student is pouring over an nmr of a compound you need to complete a manuscript. Two students are arguing at the blackboard over the interpretation of analytical data. In the background strains of Beethoven's 6th symphony, well, maybe Dire Straights' popular hit, "Money for Nothing . . .", come from an old tape deck installed many years ago by a former student who is now a successful professor at a respectable university.

You smile and return to your office to put the finishing touches on a manuscript that promises to have a major impact in your field. You have much to celebrate today because your program director called yesterday to inform you that your grant had been renewed.

A few weeks later a colleague from industry, after carefully reading a preprint of your seminal paper, comes for a visit and decides that a long term investment in your project is a wise decision. The company invests, and five years later a patent is filed that promises riches for all.

The curtain drops, with the lyrics of the Dire Straights' hit "Money for Nothing . . ." strumming away in the background.

Too good to be true? Wishful thinking? Most of us would answer yes. All is not well in the world of science and technology; and in some way, the relationship between industry, academia, and government comes up again and again as a major source of the problem.

The Council for Chemical Research, CCR, is addressing the complex problems that places this happy story in the category of myth. The Council's makeup positions it uniquely to address the issues that stand in the way of a productive relationship between academia and industry as detailed below. But first some provocative statements and some history that will set the stage for what CCR has been able to accomplish towards improving the industrial/academic interface.

Contrary to popular belief industry and academia are working together to improve the welfare of this country. Contrary to popular belief industry is making a major effort to clean up the environment. Contrary to popular belief man made chemicals such as pesticides are not primary sources of cancer in man. Unexpected statements from an academic? Eleven years ago, yes. Today, no.

Eleven years ago, Mac Pruitt, then Vice President for Research at Dow Chemical, brought together leaders from academia and industry concerned with research and development in the chemical sciences and engineering. Pruitt observed that at that time, "there was a distinct feeling in the scientific community . . . that we were about to lose our technology lead in the world." He believed that one of the main reasons for this was that "industry and universities were no longer cooperating. In fact, they had almost become antagonistic to each other." Pruitt called the meeting in an attempt to determine the extent of the problem and to seek a solution.

He made the following observation of those gathered in September 1979 in Midland, Michigan.

From the very beginning, you could see that we did have a real problem because everybody, from the university particularly, had a big question: 'What are these guys up to now? Anybody who would invite us here and pay our way, must be up to some scheme.' There was an aura of suspicion or wonderment all through the conference Most of the people had never met each other.

Up to this time many people had been running around the country, meeting and wringing their hands over the ensuing crisis in science and technology, but nothing much had happened. Pruitt decided that we needed to go beyond the Midland meeting and the Council for Chemical Research was incorporated

in late 1980. The three interlocking components of CCR's logo shown in Figure 1 represent academia, government, and industry.



Figure 1. The CCR logo.

CCR has come a long way since then. Although CCR cannot claim with certainty to be a primary player in helping maintain the health of a vast and far reaching industry, it has had an impact, and its potential for further contributions is significant.

CCR is unique in the United States. The organization brings together leaders from academia and industry in an area crucial to the nation's future. Research in the chemical sciences and engineering is central to achievements in the medical sciences, biotechnology, materials, and pollution abatement and is an integral part of one of the few industries in this country with a large, favorable trade balance (\$15.7 billion in 1989). The only other major industry left in the United States with a favorable trade balance is the aerospace industry, primarily represented by Boeing. U.S. chemical sales in 1989 were \$280 billion. The industry employs over 800,000 people, a number exceeded only in the auto and textile industries.

As noted by Philip Abelson in an editorial in the July 20, 1990, issue of Science:

Chemistry is a discipline central and essential to the other natural sciences, most of technology, and much of medicine. In the future global competition, a country not tops in chemistry is destined to be second-rate or worse.

CCR's membership consists of chemical engineering and chemistry department heads, deans, and vice presidents from 162 of the nation's leading universities and research directors and vice presidents from 50 major industrial firms. The common denominator in the organization is shared responsibility in leadership of research and education in the chemical sciences and engineering.

The Council for Chemical Research is lead by a Governing Board consisting of 18 members plus the chairman. The members of the Board are elected by the members of CCR. Those who have served as chairmen of the board are shown in Table I.

Chairmen are elected by the Board and alternate between industry and academia. Board membership is distributed evenly between industry and academia. To the extent possible a balance between chemistry and chemical engineering is maintained.

Table I. Chairmen of the Governing Board of the Council for Chemical Research

M. E. Pruitt, Dow Chemical, 1981, 1982
A. L. Kwiram, University of Washington, 1983
W. J. Porter, Jr., EXXON, 1984
K. B. Bischoff, University of Delaware, 1985
K. I. Mai, Shell, 1986
P. G. Gassman, University of Minnesota, 1987
E. C. Galloway, Stauffer Chemical, 1988
C. J. King, University of California, Berkeley, 1989
H. S. Eleuterio, duPont, 1990
J. I. Legg, Auburn University, 1991
R. D. Gerard, Shell, 1992
T. F. Edgar, University of Texas, Austin, 1993

CCR's programs and activities are designed to improve research communication, enhance the quality of science education, and encourage a rational discourse on the impact of science and technology on society. The programs can be broken down into seven major areas as summarized in Table II.

Table II. Council for Chemical Research Programs with Responsible Committees

Science and technology transfer meetings.
(University/Industry Interaction Committee)

Programs to address improvement of science education and the supply of scientists and technologically trained people. (Public Relations and Scientific Manpower and Resource Committees)

Production and distribution of video tapes on the impact of science and technology. (Public Relations Committee)

Testimony to Congressional committees and recommendations for key government positions in science and technology. (Government Relations Committee)

Annual meeting. (Program Committee)

Awards. (Awards Committee)

Distribution of unrestricted support for universities. (Chemical Sciences & Engineering Fund Committee)

Science and technology transfer meetings assume two formats which in many respects are mirror images of each other. One type of meeting involves identification by leading industrial scientists of basic research needs for emerging new industrial technologies. Two of these so called CCR University/Industry Interface Symposia are summarized in Table III.

Table III. Industry to University Transfer: CCR University/Industry Interface Symposia

"Opportunities for Basic Research in Industrial Separations" AIChE Meeting, San Francisco, November 1989

"Basic Research Needs for Tomorrow's Industrial Catalysis" 12th North American Meeting of the Catalysis Society, Lexington, Kentucky, May 1991

The emphasis in these symposia is on transfer from industry to academia. Industrial scientists make presentations to a primarily academic audience with the objective of motivating scientists working in basic research to attack problems of interest to industrial researchers.

James Roth (Air Products), a member of CCR's Governing Board and a leading scientist in catalysis research, noted in a recent C&EN article (September 3, 1990, p. 30) that our nation is lagging behind Japan in catalysis development. CCR's participation in the conference on catalysis to be held in Lexington in 1991 is in response to this concern.

The mirror image of these meetings are the so called NICHE conferences summarized in Table IV. NICHE is the acronym for New Industrial Chemistry and Engineering Conferences.

Table IV. University to Industry: New Industrial Chemistry and Engineering (NICHE) Conferences

"Future Directions in Polymer Science and Technology." Keystone Resort, Colorado, May, 1990.

"Future Directions in Environmental Science and Technology." Scheduled for Spring 1992.

The emphasis in these conferences is on transfer from academia to industry. A recent highly successful NICHE conference on polymer science

and technology was held at the Keystone Resort in Colorado. Key to the success of the conference was the organizing committee consisting of industrial representatives from major U.S. companies, namely, Air Products, Exxon, duPont, General Electric, Union Carbide, Eastman Kodak, and Dow. The organizing committee, chaired by Lloyd Robeson (Air Products), invited key polymer scientists from academic institutions in the U.S., Canada, France, and Japan to make presentations to a primarily industrial audience.

The meeting followed a Gordon Conference format with extensive opportunity for informal contact. Attendance was limited to 100. A survey of attendees showed that over 90% found the conference valuable and encouraged continuation of this meeting format. A NICHE conference on "Future Directions in Environmental Science and Technology" is now on the drawing boards. Robert Moolenaar (Dow) is chairing the organizing committee.

Because of our unique industrial/academic interface, we are in a strong position to support programs concerned with the improvement of science education and the supply of scientists and technologically trained people. Several examples of our activities in this area are shown in Table V.

**Table V. Education Programs Supported by the Council
for Chemical Research**

Seminal workshop for middle school science education sponsored with EXXON.

Financial and advisory support for the production of the "World of Chemistry," an Annenberg/CPB Project educational television series.

Support for Operation Progress directed by Glenn Crosby at the 11th Biennial Conference on Chemical Education.

The exploratory workshop held in February, 1990, at the EXXON Education Center in New Jersey, focused on programs that are being developed by industry and academia to improve middle school science education. As a result of this seminal workshop additional workshops are being held. Information from these workshops will be used in an intersociety project initiated by Paul Gassman, Past President of the American Chemical Society, to produce and disseminate a comprehensive survey of education programs.

The Council for Chemical Research played a critical role in the production of the World of Chemistry. CCR was responsible for raising most of the industrial support needed for the project. In addition, I represented CCR on the World of Chemistry Advisory Committee where I helped edit the series.

The industrial support, together with support from the Annenberg/CPB Project and the National Science Foundation, was used to produce 26 half hour video tapes for an educational television series for college and high school students. The series is also serving an important function in conveying the central role played by the chemical sciences and technology in our society.

Dow Chemical USA and Exxon are utilizing the World of Chemistry tapes in employee orientation programs, and Dow is expanding usage overseas. The tapes are finding their way into precollege classrooms, for both student education and teacher enhancement. The World of Chemistry had the largest prebroadcast distribution of any educational television series in history. The series is being aired by Public Television to affiliates across the country.

The Council for Chemical Research is currently involved in helping raise support for The Molecular World, a prime time public television series similar in concept to the Planet Earth series. Nobel Laureate, Roald Hoffmann, the narrator in the World of Chemistry series, is the Science Editor for The Molecular World.

As a final example of our involvement in educational programs, CCR provided Glenn Crosby with partial support for the highly successful Operation Progress program for high school chemistry teachers in the southeast held in conjunction with the 11th Biennial Conference on Chemical Education in Atlanta in August, 1990.

Fred Leavitt, Executive Director of CCR, and I were witness to the Operation Progress workshop's success. The workshop included experience with computers, lectures on teaching chemistry by Professor Crosby, and extensive hands on chemistry focusing on micro laboratory instruction and a fascinating laboratory built completely around materials that can be purchased in local grocery and hardware stores. This creative laboratory when used by students and teachers should not only promote an interest in chemistry but underline the pervasiveness of chemistry by connecting the laboratory directly to the real world.

Science and mathematics education is closely related to human resources. NSF's recent restructuring of the education directorate to include human resources underlines this vital link. However, the question of human resources is complex. There are those who believe we are in a crisis situation and others who believe that supply and demand will take care of our needs. It is important that we do not give a mixed message to the United States Congress in our appeals for support for research and education.

CCR's Scientific Manpower and Resources Committee held a workshop on human resources in October, 1990. Representatives from NSF, AIChE, and ACS participated. This is a first step in our effort to bring about a more cohesive understanding of the manpower issue and, thereby, facilitate finding effective solutions to the problem.

The Council for Chemical Research has also been involved in the production and distribution of video tapes designed to educate scientists, students, educators, government scientific decision makers, and the public about the impact of chemicals on the environment. These tapes are listed in Table VI.

**Table VI. Video Tapes Produced and Distributed
by the Council for Chemical Research**

"Carcinogens, Anticarcinogens and Risk Assessment" Presented by Bruce N. Ames, University of California, Berkeley.

"Changing Patterns of Cancer in the United States." Presented by Philip S. Cole, University of Alabama Medical School.

"Big Fears . . . Little Risks" Narrated by Walter Cronkite. Sponsored by the American Council on Science and Health.

Two tapes have been made in an attempt to put into rational perspective public fears of man made chemicals in the environment. One tape involved a lecture by Bruce Ames, an expert on risk assessment, and the other a lecture and interview with Philip Cole, one of the world's leading cancer epidemiologists. CCR has also supported the distribution of a tape entitled, "Big Fears . . . Little Risks" narrated by Walter Cronkite which does a very nice job of bringing together the material presented by Professors Ames and Cole.

The focal point of CCR's activities is the Fall annual meeting. Meetings have been held across the United States for the past 10 years, hosted by local member industries and universities. The annual meeting provides an opportunity for the entire membership to interact in programs focusing on areas of mutual interest to university, industrial, and government scientific decision makers.

The 1989 annual meeting had education as one of its themes. The 1990 meeting had programs dealing with environmental control in the '90's, frontiers in chemical sciences and technology, and university/industrial/government interactions in research.

During our annual meeting, CCR makes an award to a person singled out as most exemplary of CCR's mission. The "Mac Pruitt Award" recognizes outstanding contributions to the progress of chemistry and chemical engineering by promotion of mutually beneficial interactions between universities and chemical industry. The award includes \$5000 to be given by the awardee to a chemistry or chemical engineering department of his or her choice.

Although I have stressed university/industrial interactions in this talk, I should note again that CCR's symbol contains three interlocking components, one of which is government. In order to enhance CCR's dialogue with government, it was decided to move the Bethlehem, Pennsylvania, headquarters to Washington, DC, in 1990. CCR is involved in testimony to Congress and recommendations for key government posts in science and technology. We are working with other scientific organizations to improve the effectiveness of these activities.

As noted earlier in the paper, "Although CCR cannot claim to be a primary player in helping maintain the health of a vast and far reaching industry, it has had an impact." The interaction between industry and academia that has developed through the activities discussed has been a catalyst to improved interaction on the one-on-one level. Many of us can attest to the exchange of research and technology information through visits to each other's research operations brought about because of initial CCR contacts. These visits have led to funding commitments to universities by industry. Financial gains demonstrating the increased investment of industry in academic basic research since CCR was formed, are shown in Table VII.

Table VII. External Funding for Academic Research

	Chemistry		Chemical Engineering	
Total Funding	Industrial Funding	Total Funding	Industrial Funding	
	(\$M)	(percent of total)	(\$M)	(percent of total)
1981	186	7	52	23
1983	278	9	90	31
1985	345	11	91	44
1987	500	12	114	42

A recent article in *Chemical and Engineering News* (November 5, 1990, p. 24) on the NSF Presidential Young Investigator Program had the following to say about CCR:

Chemists and chemical engineers have done somewhat better than average in obtaining industrial funds, in no small part because of the efforts of the Council for Chemical Research The organization itself has actively sought to spread the word about the PYIs by distributing information to its members about each new group of awardees.

The quote refers to the behind-the-scenes work of CCR's University/Industry Interaction Committee.

Although industry targets most of its support of academic research, an industrially supported Chemical Sciences and Engineering Fund has been established by CCR that provides small amounts of unrestricted support for chemistry and chemical engineering departments. As those in academia can appreciate, unrestricted support is often of considerable value.

The Council for Chemical Research's potential for further contributions is significant. There is still much that can be done to improve academic/industrial interactions. In the Spring 1990 issue of *Issues in Science and*

Technology, Paul Gray, President of MIT, wrote an article entitled "Advantageous Liaisons" in which he discusses the different mode of academic/industrial interaction practiced by foreign companies. Gray states:

"The Japanese in particular have proven themselves adept at scouring the world's pool of new knowledge, objectively exploring and evaluating the potential of novel ideas, and boldly investing in the ones with the most promise. As part of this process, they have sought to establish ties to many American research universities. They join liaison programs, they sponsor on-campus research, they send visiting scientists to university laboratories, and they even provide funding for university endowments, helping to maintain the long-term health and productivity of the resource."

"In contrast, many U.S. firms have been much more reluctant to invest in the longer-term potential of emerging technologies. And they are much less willing to seek out and pursue ideas that come from outside their own laboratories, even from U.S. universities. Many faculty members are complaining these days that whereas U.S. firms have resisted their pleas to support novel research programs on campus, Japanese firms are often standing in line."

In the June 25, 1990, Wall Street Journal, Alan Murray and Urban Lehner, in a cover story article entitled, "Strained Alliance: What U.S. Scientists Discover, the Japanese Convert--Into Profit," support Gray's thesis but go beyond it. They recognize that improving the academic/industrial interface is a two way street. In support they quote a recent Ph.D. graduate in engineering as follows:

In graduate school in the United States, everybody wants to be in basic research, not commercial research. It's more aesthetically pleasing. Graduate students believe that if you join a company, your work may not be published and you won't advance as a scientist.

As noted by Murray and Lehner, "In applying technology, U.S. falls short for reasons both corporate and cultural." The issue is clearly complex and has no simple solution. Indeed, a growing number of U.S. industries think of themselves as global companies.

CCR has a Science Advisory Board whose assignment is to look to the future with the directive to recommend programs that best take advantage of CCR's unique industrial/academic interface. The Science Advisory Board is currently looking into the relationship between CCR and the growing international environment in which chemical research and development is being conducted.

In the Wall Street Journal article Murray and Lehner conclude with a discussion of the inroads Japan is beginning to make in the aerospace industry. They, again, note that these inroads are being made by using technology that

was created in the U.S. but largely left unexploited. Lawrence Clarkson, Senior Vice President at Boeing, states of the Japanese, "Today they're looked at by the world as subcontractors. Fifteen years from now they'll be major players . . ." Iida, chairman of Mitsubishi, is more pointed when he says, "If you (the U.S) get out of the business of making airliners, if you let what happened to you in other industries happen in aircraft, your economy will really go downhill."

Is this an exaggeration? And most certainly it could never happen in chemistry and biotechnology. But there is Germany with the largest chemical companies in the world and then there is East Germany . . . or there was East Germany.

If we are to maintain a healthy economy, we are going to have to continue to improve industrial/academic ties. We still have the world's greatest universities and we are still leaders in the chemically based industries. We must not only maintain this leadership, we can strengthen it . . . if we work together.

The Council for Chemical Research is an organization with growing recognition for its unique structure and potential. We are in a position to achieve what other organizations may not be able to accomplish. Within the last year, CCR has been approached by the Dreyfus Foundation, Research Corporation, and the National Science Foundation to consider joint efforts between these organizations and CCR in which CCR will play a central role. Our unique industrial/academic interface is emphasized in these solicitations.

Henry McGee, Director of the Division for Chemical and Thermal Systems at NSF, in asking CCR to play a major role in developing an industrial/NSF supported program for single investigators, wrote:

"A major outcome of CCR has been the developing trust and rapport between industrial and academic practitioners of pure and applied chemistry. Your organization is well positioned to assist me."

It is precisely this trust that is at the core of CCR's success. The trust has evolved as a result of the personal relationships that have developed through the years between our industrial and academic members who have worked together on our many projects. The wide spread mistrust that permeated the first meeting in Midland eleven years ago is being replaced by the trust factor.

The potential of the trust factor has just been tested. In many ways the Council for Chemical Research is still in its infancy, still an experiment. CCR's full impact is still to be realized. If we are to effectively meet the challenge of remaining, as Philip Abelson puts it, "tops in chemistry," we need to continue to build on the trust factor. The uniqueness of CCR's structure and the focus of its mission places the Council for Chemical Research in a singular position among scientific organizations.

Yes, it is possible for industry and academia to work together to improve the welfare of this country, and there is much left to do. Perhaps CCR's major long term impact will be that it will serve as a model for others to follow.