

Warren Seider

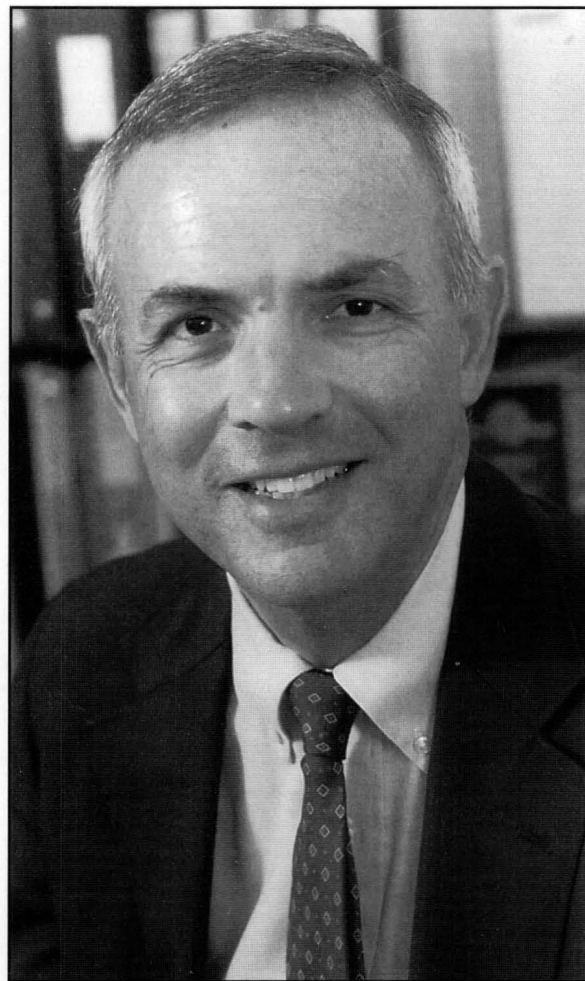
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The terms *serious*, *intense*, and *strongly motivated* apply to Warren D. Seider, but so do *enthusiastic*, *generous*, and *life-loving*. He has a unique ability to integrate new, positive experiences into his reperetory without diminishing old ones. For this reason, his professional and personal accomplishments and attainments are presented here in a somewhat chronological order.

Warren grew up in Kew Garden Hills, Queens, New York. An only child, he credits his parents (neither of whom had a college education) with strongly encouraging his academic efforts. An early aptitude in chemistry and mathematics led him to choose chemical engineering as the field for his collegiate studies, and economic considerations led him to choose the Polytechnic Institute of Brooklyn (PIB), since he could still live at home.

With the perspective of forty years, Warren considers that the choice of PIB was a good one since he received a sound undergraduate education in terms of content, teaching, and personal attention. (The wisdom of his choice of field needs no comment here.) With a wider range of choice for graduate work, he attended the University of Michigan (more will be said later about this stage in his life). This educational path was a common one for chemical engineers of his generation. As an aside, it was noted by a recent assemblage of Nobel Laureates in Chemistry at the Chemical Heritage Foundation that they, too, were almost all children of first- or second-generation im-



migrants without a college education who took advantage of parental academic aspirations and the public schools of New York to demonstrate their capabilities and then went on to do doctoral work at one of the great national universities.

Six summers of his scholastic years were spent at overnight camps in Massachusetts, and for one or more years he was (not surprisingly, in view of later developments) selected for the All-Around Camper Award. He feels those experiences stimulated his life-long love of camping, hiking, and other athletic activities. During the first two summers of his collegiate career, he worked in the dining room of a Catskills resort, where he attained his first insight into the management of a large system, had an opportunity to learn ballroom dancing, and was introduced to the pleasures of fine dining.

In preparation for his Bar Mitzvah, Warren was trained to serve as a cantor for the Shabbat services of his youth group, sharing that responsibility with the subsequently well-known Arthur Garfunkel. He attributes that expe-

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At the time when he was starting his academic career, some of the Penn faculty were not prepared to accept computer-aided design as a proper subject for academic research. Warren and his counterparts at other universities gradually overcame this prejudicial view by means of the intrinsic, scientific character of their work as well as eventual recognition of its obvious importance in both education and industry.

rience as the origin of his life-long love of singing, which he continues to this day to practice in his local synagogue choir. He also often appears to be on the verge of joining in with the Philadelphia Orchestra when they play a particularly inspiring passage, but he confines himself to conducting.

The summer after Warren's junior year at PIB, he worked for Diamond Alkali at their Research Center in Painesville, Ohio. He was primarily involved in experimentation with Don Geaman, but was introduced by John H. Perkins to the use of an LGP/30 digital computer to speed up tedious calculations of parametric equilibrium. On his return to PIB in the fall, he discovered that an IBM 650 had been acquired in his absence, and he was able to expand his knowledge of machine computation by modeling the kinetics of nuclear reactions for Professor Robert F. Benenati.

The summer after completing his BS degree, he worked in Parkersville, West Virginia, at the E.I. Dupont Company's research laboratories, measuring the rates of permeation of fluorocarbons through membranes. He received compliments from a vice-president on the content and quality of his final report, but this turned to criticism when he mentioned that he had completed the report while on a visit to his home in Queens. Warren says this experience influenced his subsequent decision to follow an academic career where he would be able to share his technical accomplishments with others.

With four alumni of the University of Michigan on the PIB faculty (Warren McCabe, Don Othmer, Len Naphali, and Irving Miller), Warren was probably destined to go there for his graduate work. He chose to do his doctoral research with the author of this article on confined-jet mixing in the entrance of a liquid-phase tubular reactor. Although the flow was laminar upstream and far downstream, both the experimental and the numerical modeling revealed an unanticipated instability and rapid, turbulent-like mixing in between that posed complications, severely testing his skills and persistence.

In what is now an unusual occurrence, Warren spent the summer following his second year of graduate work at the Central Basic Research Laboratories of Esso in Linden, New Jersey, working on a bench-scale column-crystallizer. Dr. Robert Long complimented Warren on his experimental skills and cautioned him to resist the temptation to concentrate on

theoretical analysis using a digital computer. That suggestion may account for the limited, but frequent, element of experimentation in his subsequent research.

Upon completion of this summer work, Warren was forced to delay continuation of his doctoral work in order to manage his father's wholesale pharmaceutical sundries business for two months when his father suddenly fell seriously ill. He says this experience taught him two invaluable lessons: first, how to manage the unexpected complexity of handling 2000 individual items for 200 drugstores, and second, an appreciation of how much individual responsibility and creativity had been required of his father to start and maintain such a business. He says this experience was an additional factor in his decision to follow an academic career where he would have a high degree of individual responsibility and an opportunity to be creative.

Warren's doctoral research was not the only influential experience of his graduate years. He particularly cites his extensive course work as well as the presence of Professor Joseph Martin and Brice Carnahan as role models in teaching and Professors J. Louis York and G. Brymer Williams as role models in terms of professional outlook.

During this time period, a unique opportunity that was to have a profound influence on his career presented itself. In 1958, Donald L. Katz began a study under the auspices of the Ford Foundation to assess whether or not computers had a present and future role in engineering education apart from research. That may seem to be an oxymoron today, but a "yes" answer was not obvious to many faculty members at that time. Indeed, one of the findings of the study was that those few professors who knew how to use a computer were almost all favorable to the concept of using computers in their own courses, whereas most of those who did not were opposed. One conclusion was that courses in design would be the most certain beneficiaries of such computer use.

Don Katz then persuaded the National Science Foundation to fund a project where faculty members from all fields of engineering all over the country would be provided with materials to assist them in using a computer for instruction in design and would be taught how to use a computer in that context. In 1965, he and Brice Carnahan undertook that mission. First, forty faculty members were invited to Ann Arbor

Through the years...



At a CACHE meeting (1974) with Ernest J. Henley, J.D. "Bob" Seader, Rodolphe L. Motard, Richard R. Hughes, and Lawrence B. Evans

Warren accepting the Medal of the City of Paris from Mayor Jacques Chirac (1983)



Warren after tennis with Renate and Stuart Churchill (1981).



Warren with Penn faculty, former students, and close associates at World Congress of ChE, Japan (1986).



Hiking in Colorado with Diane and Benjamin (2000).

to further their own learning with respect to computers and to help formulate appropriate materials, including problems, for teaching design. Warren was invited to serve as a graduate assistant on the project and to help solve the newly formulated design problems. He then helped to organize workshops at seven locations where two faculty members from each engineering school would come. Warren, who never fails to benefit from any experience, says that making arrangements for 700 separate travelers gave him new insight into the geography of the United States as well as the ability to determine the least expensive itineraries. He was, in this context, able to use for the first time a time-sharing computer (the GE 235) and teletype terminals to carry out interactive solutions. It might be noted that working on this project strongly influenced the direction of the careers of many of the other participants, including Lawrence B.

Evans, James O. Wilkes, Brice Carnahan, and Rodolphe L. Motard. It also established a working bond among them that persists to this day.

Although he completed his doctoral work in August of 1966, he remained at the University of Michigan for another year in order to continue participation in the NSF project and to take advantage of an opportunity to assist in teaching the course in process design using the new approach and materials. He also had an opportunity to use, in conjunction with Professor Bert Herzog, an interactive computer, the DEC 338, with a graphical display and a light pen. This introduced him to computer graphics, a subject he would pursue at the start of his own faculty career.

In 1967, he accepted a quite unexpected offer of an Assistant Professorship from the University of Pennsylvania, two-

thirds in Computer and Information Sciences and one-third in Chemical Engineering. He attributes that opportunity to Professor Arthur E. Humphrey, who foresaw the important future of this new field. Warren made significant contributions to Computer and Information Sciences by creating (with Professor Aravind Joshi) the first curriculum in Computer Science and Engineering at the University of Pennsylvania and by teaching both the freshman course in computer science for all engineers and a pioneering graduate course in computer graphics. He says that throughout his career he benefited from the interaction with his colleagues in CIS, but he gradually became more involved in chemical engineering, and eventually his appointment was shifted wholly there.

He soon set out to introduce the use of computers in the chemical process design course, but found that the students were insufficiently prepared. That led he and Professor Alan L. Myers to write a book for the sophomore course in material and energy balances. The book, *Introduction to Chemical Engineering and Computer Calculations*, is generally viewed as a real technical success, but too far ahead of its time to be a best-seller. Warren asserts that the collaboration itself had lasting personal benefits in that he learned from Alan to be more disciplined in presenting technical arguments and how to edit with the objective of creating a concise text. He also concluded, with typical long-range planning, that he would concentrate on research and not return to book-writing for ten years, by which time faculty members nationally would be more prepared for such an approach. That hiatus turned out to be twenty years.

At the time when he was starting his academic career, some of the Penn faculty were not prepared to accept computer-aided design as a proper subject for academic research. Warren and his counterparts at other universities gradually overcame this prejudicial view by means of the intrinsic, scientific character of their work as well as eventual recognition of its obvious importance in both education and industry. Warren says the unwavering support of Art Humphrey, both as Department Chairman and later as Dean, was a critical counterbalancing factor in this regard.

In 1974, Professor J.D. (Bob) Seader, Richard R. Hughes, and Warren attended a meeting in St. Louis (hosted by Al Pauls) on the Monsanto FLOWTRAN simulator. They immediately decided to write a book on simulators for teaching purposes. That decision led not only to the book *FLOWTRAN Simulation—An Introduction*, but also to a long-time collaboration in presenting short courses in the AIChE Today Series. One course was taught at 57 AIChE meetings and a more advanced one at 28. After Dick Hughes' untimely death, his place was taken by Professor Larry Biegler. Warren praises unstintingly the efforts of Harold (Hal) Abramson for his promotion of and arrangements for these courses. He also re-

calls that confusion often ensued because of the similarity of the names *Seader* and *Seider* and the fact that they usually roomed together when giving these courses. Warren says he never objected when falsely given credit for the famous Chao-Seader correlation.

Warren transmitted his love of sports, including tennis and hiking, to all of his family, and they meet regularly for recreational vacations together, usually in the western United States. It is a privilege to see the sparkle in Warren's eyes when he describes a vista they have chanced upon in the Rockies, Tetons, or Sierra Nevadas.

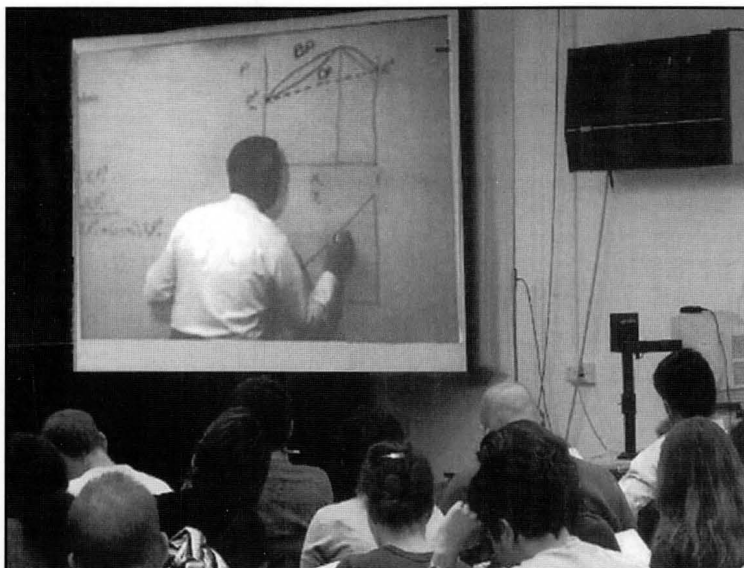
In 1974, Warren was torn between taking his first sabbatical at Cambridge, England, or at Cambridge, Massachusetts. In this no-lose situation he finally decided to go to MIT to work with Larry Evans on process simulator research and a book. Although they did not find time to write the book, Larry went on from their interaction to found Aspen Technology, and on his return to the University of Pennsylvania, Warren shifted the focus of his research in the direction of writing new algorithms for multiphase chemical equilibrium and heterogeneous distillation for process simulators such as ASPEN.

Warren spent his second sabbatical in 1983 at the Danmarks Teckniske Hojskole, where he worked with Professor Michael Michelsen. In that same year he presented a plenary lecture at the Computers in Chemical Engineering conference in Paris and was awarded the Medal of the City of Paris at the Hotel de Ville by then-mayor Jacques Chirac.

Warren gradually came to the conclusion that education in process design was more akin to that in laboratory courses than to that in courses in engineering science. This led him to develop multimedia forms of presentation and communication for problem-solving techniques. On his third sabbatical, spent at the Technion in Israel, he devised and used extensive sets of transparencies because he recognized that the students there had an incomplete comprehension of his oral presentations in English. This led to the preparation and publication of *Process Design Principles: Synthesis, Analysis, and Evaluation* with Daniel R. Lewin of the Technion and Bob Seader. This coupling of information technology and teaching is exemplified by the recent photograph of Warren lecturing to the students and Danny Lewin at the Technion in visual as well as oral communication with one another over Internet 2.

In lieu of a detailed listing and discussion, the impact of his professional accomplishments is summarized by the following excerpt from a letter written to support his nomination for the *Computing in Chemical Engineering* award of the AIChE, which he received in 1992.

His record of leadership is unsurpassed. He served as



Warren presenting a video lecture from Penn to the Technion over Internt 2 (2001)

Chairman of the AIChE Machine Computation Committee. He was instrumental in founding the CAST Division of the AIChE and served as Chairman. He was one of the key founders of the CACHE Corporation and served as its first President. He shared the lead in organizing the first International Conference on Foundations of Computer-Aided Process Design and served as Co-Chairman. He was Director of the AIChE from 1984-86 and, with Bob Seader, straightened out long-standing problems in AIChE publications. As a result, the frequency of *AIChE Journal* issues doubled and the modernization of *CEP* was begun.

His contributions to education include the pioneering textbook co-authored with Prof. Alan Myers, which was one of the first computer-based books on material and energy balances. His textbook on FLOWTRAN with Bob Seader has introduced a generation of students to computer-aided process design. He has conducted over 200 short courses and presentations on computer-aided design and mathematical modeling. Most recently, he has directed the production of a series of innovative PC lessons for undergraduate courses, other than design, in chemical engineering.

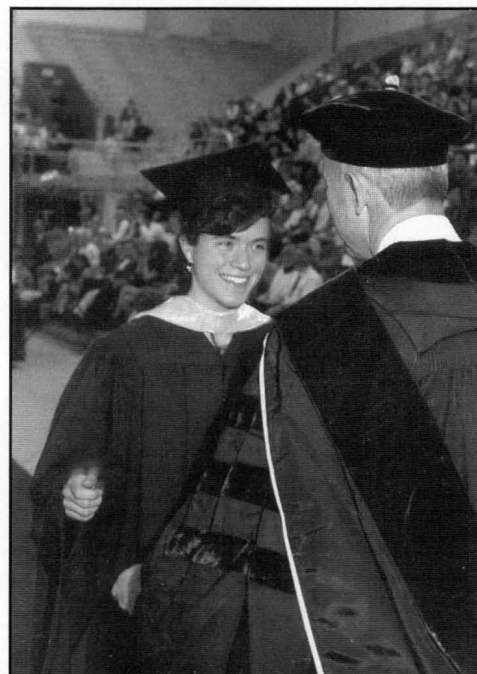
Warren's research has been at the forefront of the field and he has led the way in establishing chemical engineering computing as a major research area in chemical engineering. He has made major contributions in the field of equation solving, computing architectures for process simulation, computation of simultaneous phase and chemical equilibrium, simulation of three-phase distillation columns, steady-state and dynamic azeotropic distillation, synthesis of models and algorithms for process analysis and design, and supercritical extraction. More recently, he has moved strongly into nonlinear analysis with emphasis on control and unusual phenomena.

It should be added that as a Director of the AIChE, the thoroughness of his preparation for Council meetings, including the assemblage of documentary materials, is legendary. Also, a fuller account of his singular contributions, along with those of others, to the formation and development of the unique CACHE organization, may be found in a history by Seader and Seider.^[1]

Space does not allow a detailed description and analysis of Warren's research beyond a simple listing of his Doctoral students (see Table 1). It may be safely said, however, that his research demonstrates the logical and replanned sequence that characterizes all of his efforts,

**TABLE 1
Warren D. Seider's
Doctoral Students**

- | | |
|-------------------------|---------------------------|
| • Peter G. Ham | • David D. Brengel |
| • Sezer Soylemez | • Loretta G. Koster |
| • Jeffrey H. Kulick | • Soemantri Widagdo |
| • Rajeev Gautam | • Amy C. Sun |
| • Bradley A. Ross | • Evangelia A. Gazi |
| • George J. Prokopakis | • Roberto Irizarry-Rivera |
| • Charles W. White, III | • Leighton B. Wilson |
| • Joseph W. Kovach, III | • James R. Phimister |
| • Tulio R. Colmenares | • Joshua M. Kanter |
| • Miriam L. Cygnarowicz | • Angel Caballero |



Warren presenting daughter Deborah her Masters Degree in Computing and Information Science (1997)

and that the accumulative impact is greater than the sum of the parts. Its focus has been on the development of computational algorithms for complex physical and chemical systems, involving optimization and non-linear analysis, in process design and control.

As can be inferred from its focus on process design, control, and simulation, much of Warren's research has a direct or indirect impact on education. One other aspect of his contribution to education is connected with the process design course at the University of Pennsylvania. Melvin C. (Mike) Molstad and A. Norman Hixson took advantage of its location near a center of the chemical and petroleum industries to involve local practicing engineers in the

senior design course, thereby making it a special experience for the students. Warren eventually inherited responsibility for this course and with his exceptional energy, organization skills, and dedication took it to new heights. The practicing engineers not only generate a new and realistic problem each year for each group of three students, but also attend the weekly meetings between the students and their faculty advisors. This course is undoubtedly the high point of the undergraduate academic experience for most of the students.^[2] One key to its success is the preparation in the core courses using the multimedia CD-ROM developed by Danny Lewin, with Warren and Bob Seader, thereby allowing the students to devote their attention primarily to the creative and competitive aspects of the design. Another has been the collaboration in teaching with Professor Bill Luyben (Lehigh) and Chris Floudas (Princeton) in recent years.

One of the traditional events of Penn's Chemical Engineering Department is an annual canoe outing on the Delaware River. A prominent academic is invited to participate and to give a seminar the next day. Warren took over responsibility for this affair when Art Humphrey, its initiator, left. He soon added a hiking and camping trip the day prior to the canoeing, allowing him to introduce our undergraduate and graduate students to this activity he loves so much.

Warren enjoys many sports, both as a participant and spectator. He has been a regular member, along with Dan Perlmutter and the author, in a faculty foursome that has played tennis two hours weekly for 25 years. Many other faculty members and graduate students have rotated through the fourth slot. Warren considers that by this experience we have thereby made a significant contribution to the future lives of these students.

In 1969, a team of Art Humphrey, Warren, Malcolm Lilly, and the author responded to a challenge from the University of Colorado to a four-mile relay race. We won, contributed a trophy, and invited other schools to enter the following year. We won again in 1970, with Alan Myers substituting for Malcolm Lilly, and thereafter retired undefeated.

Warren met Diane, his wife-to-be, at Hillel at the University of Michigan, and they were married about a year-and-a-half later, almost coincidental with the completion of his doctoral work. There is a rumor that their honeymoon began with a camping trip in northern Michigan, but was soon diverted

to more elegant surroundings in Bermuda. Diane majored in Music Education, but has spent her career primarily as a teacher specializing in learning disabilities. Warren credits her management of their household, grounds, and finances with allowing him to concentrate more of his energies on professional activities and family life.



Sailing in the Greek Islands; Warren and Diane with Vassilis Vassiliadis, G.V. "Rex" Reklaitis, George Reklaitis, George Prokopakis, and Venkat Venkatasubramanian (1996)

Their daughter, Deborah, received a BS degree in electrical engineering and an MS in computer and information science, and their son, Benjamin, a BA in urban studies. Both now live in California. Deborah is married to Gabriel Shapiro and has given them a grandson, Joe. Warren transmitted his love of sports, including tennis and hiking, to all of his family, and they meet regularly for recreational vacations together, usually in the western United States. It is a privilege to see the sparkle in Warren's eyes when he describes a vista they have chanced upon in the Rockies, Tetons, or Sierra Nevadas.

When Warren's father and mother joined their household after retirement, Warren resumed playing golf to join him in that sport. When Benjamin became interested in scholastic and collegiate sports, Warren regularly attended such events with him, and for several years they have had season tickets for the Philadelphia Eagles football games. Warren enjoys swimming, and they once had their own pool. However, after it was destroyed twice, once by Hurricane Agnes and once inadvertently by a repairman, they did not tempt fate a third time.

As a final personal note, because it is a testimony to his character, I would like to mention that my 40-year association with Warren has evolved seamlessly from teacher-student to colleague to personal friend. We have avoided collaboration in research out of circumspection as well as different interests, but we find a few minutes almost every day to discuss professional matters, world affairs, and sporting events. My wife Renate and I began playing tennis and attending Philadelphia Orchestra concerts, among other things, with Diane and Warren more than 25 years ago. I cannot overstate my gratitude for their friendship and for the many contributions they have made to my professional and everyday life.

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