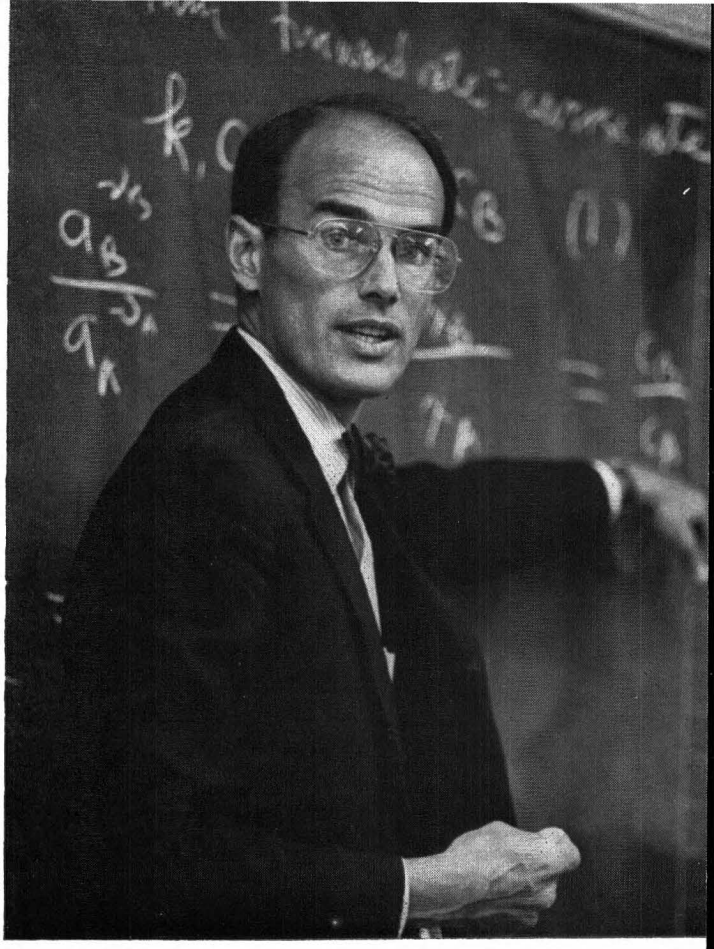
ChE educator

Dendy Sloan
of the
Colorado School of Mines

BRODIE FARQUHAR
Colorado School of Mines
Golden, CO 80401



"DENDY SLOAN IS AN academic man for all seasons," said Art Kidnay, department head of Chemical Engineering and Petroleum Refining at the Colorado School of Mines. "He is one of those rare individuals who does *everything* well."

Professor Sloan is a renaissance figure, on a campus and in a discipline dominated by specialists. "Dendy is the most balanced, well-rounded faculty member I know," said Kidnay. "*That* is what sets him apart. Other faculty on campus and around the nation are equally competent in areas like teaching, committee assignments, research, engineering education research, and work in the professional societies—but I don't know anyone quite as good in all areas."

The shelves in Sloan's office contain the usual and the unexpected. Chemical engineering texts and journals dominate, as do two large models of hydrate molecules. What is different is the strong presence of books of philosophy and literature. Books like *Zen and the Art of Motorcycle Maintenance* by Robert Persig, and Whitehead's *The Aims of Education* nestle with books by William Shakespeare, Herman Hesse and Robert Frost. The hydrate molecular models represent the specialization Sloan has sought, while the philosophy and literature books represent a curiosity that has never been satisfied with the comfort of settling into a familiar niche.

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"Dendy teaches a variety of courses," said Kidnay, "and by next year, he will have taught every undergraduate course in our department. He's done this voluntarily. Very few faculty can or would do something like that—most prefer to specialize near their own research interests, which makes it easier to teach. I know that some schools have a policy to force faculty to rotate through the curriculum in the interest of balance and keeping up with all areas of your discipline. We don't have that policy, simply because most of us don't have the time. Dendy is the only one I know who could pull it off."

Born in Seneca, South Carolina, in 1944, Dendy developed an early interest in math, science, chemistry, and physics in high school. He earned his BS in chemical engineering from Clemson University in 1965 and worked five years for duPont, working in Tennessee, Delaware, West Virginia, and South Carolina. "In the course of those four jobs with duPont," said Sloan, "I discovered that I enjoyed opportunities to be entirely self-motivated and directed. Teaching seemed like a good way to do that."

In light of his later professional accomplishments, getting into graduate school should not have been a problem. It was. "Dendy did not have outstanding grades as an undergraduate," said his Clemson uppergraduate advisor, Dr. Joseph Mullins. "As I recall, he was active in a band and still plays a pretty hot banjo. The department chairman suggested he take some math courses and reapply." Several night courses and A's later, Sloan entered the graduate program at Clemson.

"Dendy was the most organized student I've ever had," said Mullins. "He came early and stayed late and ran during the lunch hour. Pretty soon he had most of the grad students chugging away, running with him." (Sloan has run 12 marathons and typically has put in 40 miles per week over the past 20 years.)

It was at Clemson University that Sloan's role models for teaching made their impact on his career. "Clemson had an unusually strong focus on education," said Sloan. "People like Joe Mullins, Dick Harshman, and department chairman Charles Littlejohn had a real impact. As I got into graduate education, I realized that this was what I wanted to do with my life."

Sloan earned his MS from Clemson in 1972, with the thesis title of "The Combined Effects of Natural and Forced Convection in a Dual Membrane, Horizontal Parallel Plate Ultrafilter"; and his PhD in 1974, with the thesis title of "Nonideality of Binary Adsorbed Mixtures of Benzene and Freon-11 on Highly Graphitized Carbon at 298.15 K and Pressures below 10 Torr."

"I advised Dendy to get his PhD elsewhere," said Mullins, "but he insisted on getting it here. I did persuade him on the wisdom of doing postdoctoral work elsewhere." Elsewhere turned out to be Rice University, where Sloan encountered Dr. Riki Kobayashi and worked as a research fellow on determining the water content of natural gas in equilibrium with hydrates.

"It was a very high pressure time and environment," said Kobayashi. "Dendy was responsible for measuring and setting the water content specs for a high pressure natural gas pipeline, from Alaska to the lower 48. Dendy, along with Jerry Holder (currently at the University of Pittsburgh), is currently recognized as one of the primary researchers (in addition to Dr. Kobayashi) in the area of hydrates. The energy crisis really had us going—so much so that I bought a rollaway bed for Dendy. He never complained."

Methane hydrates are a molecular bond of water and natural gas, under pressure. Under certain conditions, hydrates can build up in a pipeline and plug it.

From that initial focus on hydrates as a problem, Sloan eventually branched out to explore methane hydrates as an energy solution. Rich fields of methane hydrates exist in deep oceans, as well as in permafrost regions of Canada, Alaska and Siberia. It is estimated that under United States land and territorial waters alone, there are enough hydrate deposits to provide natural gas supplies for at least 150 years, or 15 times the known supply of conventional natural gas. This unconventional form of natural gas is currently thought of as a future resource, and some of Sloan's research studies is currently sponsored by the U.S. Department of Energy.

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Sloan came to the Colorado School of Mines in 1976. Here he taught most of the undergraduate courses, specializing in thermodynamics, phase equilibria, and stagewise process design at the graduate level. His research proceeded with natural gas hydrates and included adsorption, phase equilibria, and thermal conductivity. He came for the professional opportunities, the high caliber of students, and the high degree of latitude Mines offers its faculty, who enjoy both teaching and research. He has stayed for these and other reasons.

"This is small town America," said Sloan, referring to his nine years in Golden. "You have the friendliness of a small community—Cub Scouts, a good church—and access to a big city. This is a good family place." That's important to Sloan and his wife, Marjorie, and his two sons —Trey, 13 and Mark, 10. Sloan has been active in the Scouting movement for six years and has served as an elder in the Presbyterian Church. Marjorie is a second year law student at the University of Colorado. "I've had offers for other positions, yet I haven't been able to convince myself that I'd be happier elsewhere," said Sloan.

Has he noticed any similarities between Cub Scouts and college students? "Eight- to ten-year-olds are bundles of unchanneled energy. You've

got to plan things that will hold their interest; otherwise they climb the walls. Students 18-22 years old are generally very bright and very channeled," said Sloan. "Graduate student personalities typically mirror those of the professor, but undergraduates can be a substantially different challenge. Working with undergraduates is one of the best motivators for coming into this profession, and when a school has as good

Sloan and his Cub Scout troop getting ready for the big race.

students as CSM does, it makes teaching doubly pleasurable."

Evidently, his ability to hold an eight-year-old's attention has rubbed off on his college teaching style. Students consistently rank him as one of the best teachers on campus, year after year. His peers have also recognized his teaching skills by honoring him with the AMOCO Teaching Excellence Award at CSM, and with the Western Electric Award from ASEE.

Currently, Sloan works with eleven graduate students in research focused on natural gas hydrates, vapor liquid equilibrium, and thermal conductivity. In 1982, Dr. Sloan acquired the first Western sample of methane hydrates when the Glomar Challenger brought up samples from the ocean floor off the coast of Guatemala. Shipped in chilled and pressurized containers to Sloan, the "dirty snowballs" have been divided up among laboratories at CSM and other schools. Sloan and his graduate students are trying to determine optimum *in situ* methods of releasing condensed methane molecules from the water molecules which surround them.

One of the frustrations of running a successful research operation is lack of time for personal, hands-on research. "We come in as researchers and become research managers. There is no time for lab work. I find time for some theoretical and computer work, but I really miss working in the lab," said Sloan.

In spite of these limitations, Sloan does find time for a number of other activities. These include professional service in the ASEE and other organizations, service on a variety of CSM committees, work with the innovative EPICS program at Mines, plus pondering philosophies of engineering education. He even finds time to study the personalities of faculty and students, correlating results with their career tracks.

Within the ASEE itself, Sloan is currently Chairman of the Educational Research and Methods Division and is Chairman-Elect for the Chemical Engineering Division. Within CSM, Sloan has served as chairman of the Honors Humanities Tutorial Committee, and served on the Presidential Search Committee.

"EPICS" stands for Engineering Practices Introductory Course Sequence. Because the best method for mastery of any skill is regular practice, EPICS has been designed by Sloan and other CSM faculty as a unique lab-type course, providing "real-world" environments to develop and practice engineering skills. "The emphasis is on the *process* of learning, not the *content* of engineering facts and figures. All the facts, figures and cookbook procedures we pound into students' heads have a half-life, a limited time-span of value, due to the explosion of information and research. Once a student learns the process of learning and solving real-world, open-ended problems, he or she will never have to worry about the half-life of his or her knowledge—they'll be life-long learners," said Sloan.

"We're still teaching like Saint Thomas Aquinas in the Thirteenth Century, lecturing in front of a group of students. How do we integrate new tools like computers? They are no panacea, yet I believe that the key is in experiential learning, case studies, and real-life problem solving. Mines and Harvey Mudd are two of the best places I know that are working toward this new approach of engineering education," said Sloan.

The shift from content to process will not come easily, warned Sloan. "High school teachers put a great deal of emphasis on content (students regurgitating books and lectures), as do colleges, yet we expect colleges to produce leaders and in-

novators. Giving up emphasis on content is very threatening. It forces teachers to continually learn new materials, use new tools, and to do research. It forces us to *think*."

It also forces educators to look closely at how students *feel* about the process of learning. "I'm convinced that if a student leaves a course or a school feeling badly, then we've done permanent damage to that student. He/she won't be as good an engineer as someone who left a course or school excited about what they learned. As a profession, we're not doing a good job of addressing this issue."

Sloan enjoys reading philosophy and does not see the discrepancy between the "real world" and the "world of ideas." For Sloan, engineering and philosophy are both concerned with open-ended problems. "I try to see things as part of a spectrum, not as different or isolated from the whole. Take Robert Persig's *Zen and the Art of Motorcycle Maintenance*. It presents the classic struggle between objective science and intuitive romance and shows that rather than being estranged from each other, they can be part of a whole," said Sloan.

Personality types fit into this world view. Using the Myers-Briggs Type Indicator (MBTI), Sloan has found that different personalities have different world views and are attracted to different disciplines (see "Applications of Psychological Types in Engineering Education", February 1983, *Engineering Education*).

Some people are attuned to the practical, hands-on, common-sense view of events, while others are more attuned to the complex interactions, theoretical implications or new possibilities of events. These two styles of information gathering, or perception, are known as *Sensing* and *Intuition*, respectively.

"Since faculty are predominantly intuitive," said Sloan, "and students are evenly split, I'm concerned that we may be awarding grades based on personality characteristics, rather than performance." Intuitives do better on exams prepared by intuitive type faculty, while sensing types do less well—usually because they re-read every test problem in the interest of accurate comprehension, and run out of time.

For Sloan, balance or integration is a key concept. Just as a mature personality should be able to integrate intuitive and sensing methods of learning, a mature profession (engineering education) should be able to integrate content and process methods of teaching. To all who know him, Dendy Sloan exemplifies a sense of balance and wholeness, as an individual and as a professional educator. □