



## Girding for the Next Decade in Engineering

Meet the new chairman of Caltech's engineering division. All he wants to do is make Caltech the Mecca for the great engineers and applied scientists of the world.

*Francis Clauser (pronounced as in Santa Clauser) likes being where the action will be the day after tomorrow. That's one reason he came to Caltech last July as chairman of the division of engineering and applied science. He was convinced then that Caltech was already starting to make the kinds of changes that will dominate the next decade in engineering education. And he is enthusiastic now about his opportunity to further these changes.*

Among the ideas he brings to his new job:

- Engineers today must be more science-based, more broadly educated, and more socially conscious than they used to be.
- Many of the difficulties now facing the human race as a result of the destructive effects of modern technology are not the result of engineers doing a poor job, but the outcome of a lack of perspective, responsibility, and ethical concern for the projects on which they work.
- The seventies will find engineers spending more of their undergraduate time in the humanities and social sciences as a part of their professional training. As they gain a broader sense of the world around them and identify more clearly with the thinking and needs of society, they may learn to set appropriate professional goals.
- Although undergraduates already complain about the lack of opportunity to learn a specific discipline, specialization is probably going to have to be delayed until the graduate years.
- A vast number of exciting developments are taking place in modern industry, and our classroom and research laboratories need the stimulus of hearing about them. To strengthen the ties between industry and engineering

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education at all levels, outstanding men from industry will be invited to teach at Caltech for limited periods.

Clauser first came to Caltech in 1932 when he and his identical twin, Milton, transferred from Kansas City Junior College as undergraduates studying physics. It was the time of Millikan, Einstein, Morgan, Pauling, Von Karman, Clark Millikan, and Bateman. “The environment,” he recalls, “gave me a feeling of total immersion in a sea of intellectual riches.”

As seniors, the Clausers were members of William Smythe’s famous class in electromagnetic theory—which that year also included first-year graduate students William Fowler, Simon Ramo, Dean Wooldridge, and John Pierce. Another classmate was Carl Overhage, later director of the Lincoln Laboratories at MIT—a post that Milton Clauser now holds. (Smythe’s carefully preserved grade book reveals that Fowler led this class of outstanding physics students, except for the third term, when Francis Clauser tied with Wooldridge to nose him out.)

During their senior year Smythe suggested to the Clausers that they apply for graduate fellowships in physics. “But we made two wrong assessments,” Francis admits. “First, we decided our only future in physics lay in teaching; and second, we decided we didn’t want to teach. History has proved us wrong on both counts. Having made those decisions, we looked around for something with more action where we could use what we’d been learning. Aeronautics was then, as now, strongly based in science, so it was our top choice.”

The Clausers applied for fellowships in aeronautics and waited—and waited. Von Karman’s aversion to paperwork kept their applications buried on his desk for such a long time that, in desperation, they went to see him in person. Unfortunately, they couldn’t understand the Hungarian accent cascading out around his big black cigar so they left the interview not knowing whether they had been accepted or not. They *had*, of course—and before long they even learned to understand Von Karmanese, the most important language in their lives for the next three years.

Von Karman, in turn, had his own initial difficulty with the twins. "I cannot tell you apart," he announced. "But one thing I do know; two students, two dissertations. Each of you can do one, one of you can do both, or both of you can do both, but when we are through—two dissertations!"

The two dissertations included an experimental one on turbulent boundary layers, coming out of work with Von Karman and Millikan, and a theoretical one on compressible flow, inspired by discussions with Von Karman and Bateman, the applied mathematician who was one of the world's few experts at the time on compressible flows. Even then Francis Clauser was ahead of his time. Few people studied compressible fluid flow until much later.

When Clauser left Caltech with his PhD in 1937, he went to work for Douglas Aircraft in Santa Monica. He took with him, as his bride, Caltech's humanities librarian, Catharine McMillan.

At Douglas he worked on aerodynamics and flight testing. When World War II began, he had put together a design research section which had powerful impact on the eventual course of aircraft design in the United States. It included several men who are now at Caltech with Clauser: Paco Lagerstrom, professor of applied mathematics; Hans Liepmann, professor of aeronautics; and Milton Plesset, professor of engineering science—who says that "Douglas had the best design research group, and Clauser was the best man."

The group developed new methods of designing airfoils and new aerodynamic shapes for tails, wings, nacelles, and air scoops. It urged Douglas to undertake the design of a supersonic plane, which it did—the X-3.

After the war, when Douglas formed the RAND Corporation, Clauser's design group undertook RAND's first project—the design of a satellite vehicle for the Air Force. This venture, undertaken 11 years before Sputnik, was described by Clauser in 1946, in a paper on the *Preliminary Design of an Experimental World-Circling Space Ship*.

At this point Clauser found his interests turning from industry toward research and education, and he accepted an invitation from Johns Hopkins University to establish

a department of aeronautics there. He patterned it after the one at Caltech and, like Caltech's, it became internationally famous.

During the next 19 years Clauser became increasingly intent on establishing broad-based undergraduate instruction in science and engineering—master courses to cut across disciplines and delineate scientific principles so basic that, once understood, they could be applied by a student to any specific discipline he might later choose.

His work at Hopkins brought Clauser a wide reputation as a successful educational innovator. In 1964 Dean McHenry, chancellor of the University of California's newest campus, Santa Cruz, asked him to come there and set up a new school of engineering. Even though he did not feel quite ready to leave Johns Hopkins, he did take a leave of absence in January 1965 to lay out a plan for Santa Cruz. By May he was so enthusiastic about the imaginative Santa Cruz arrangement—a full-scale university of up to 27,500 students divided into small colleges of from 500 to 800 students—that he accepted the offer to become the university's vice chancellor for academic affairs.

But the opportunity to return to Caltech last summer to replace Fred Lindvall as chairman of the engineering division and devote full time again to engineering was too exciting to refuse. He calls the current engineering faculty "absolutely first rate," and with the new members he intends to recruit, his goal is "quite simply, to make Caltech the Mecca for the great engineers and applied scientists of the world."

Clauser is as absorbed in the remote past as he is in the future, as evidenced by his deep interest in archeology. A trip through the Near and Middle East in 1960 and 1961 led Francis and Catharine Clauser to a study of ancient history and learning to read and write Egyptian hieroglyphics. Armed with these accomplishments and a lot of enthusiasm, they have visited many of the world's great archeological sites, and they plan to explore even more. Catharine Clauser predicts that it will be quite awhile before they retire to their 14 acres of redwoods at Santa Cruz.