Diary of a Grand Canyon Excursion

Obama on Campus

Questioning Curriculum

Mines

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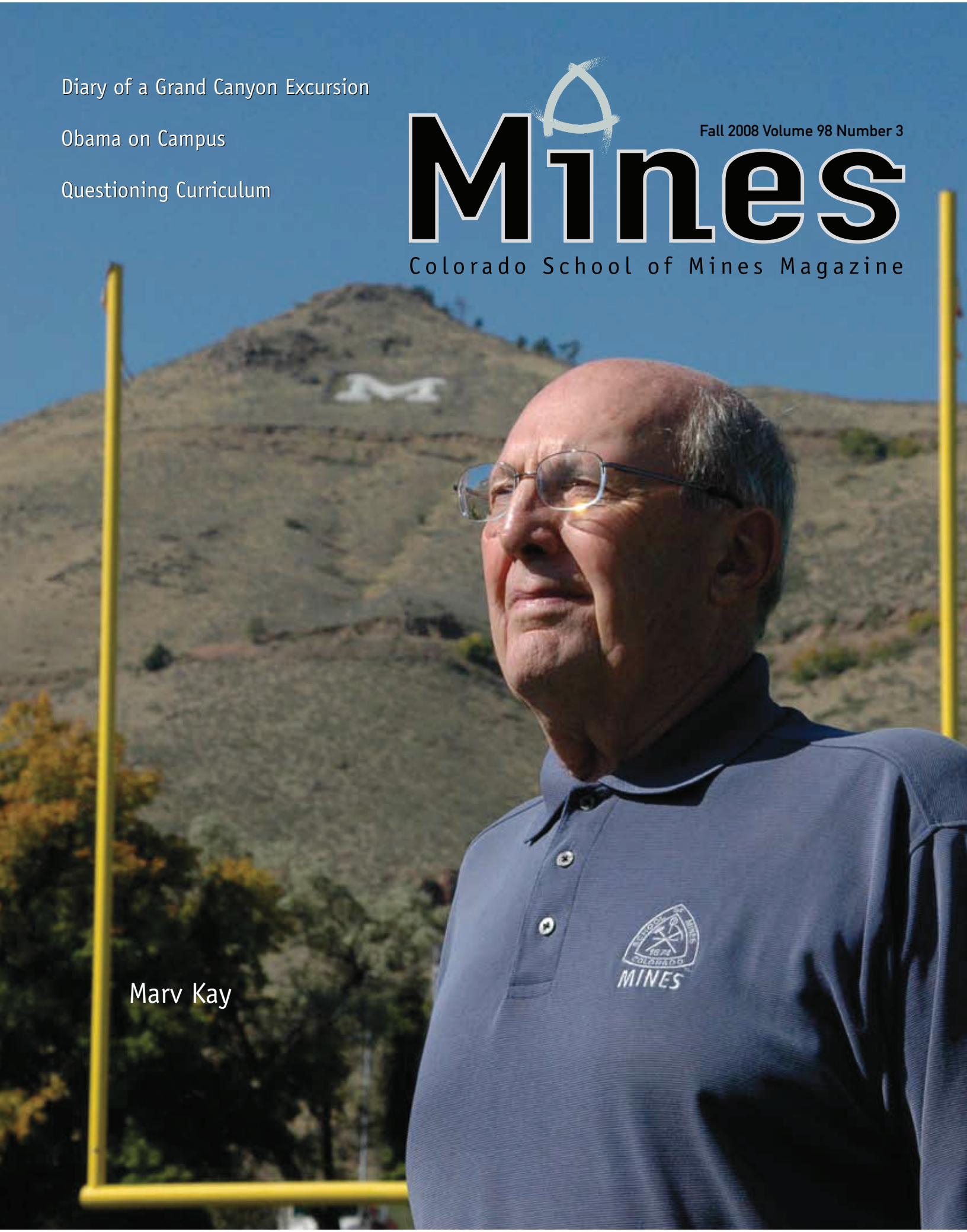
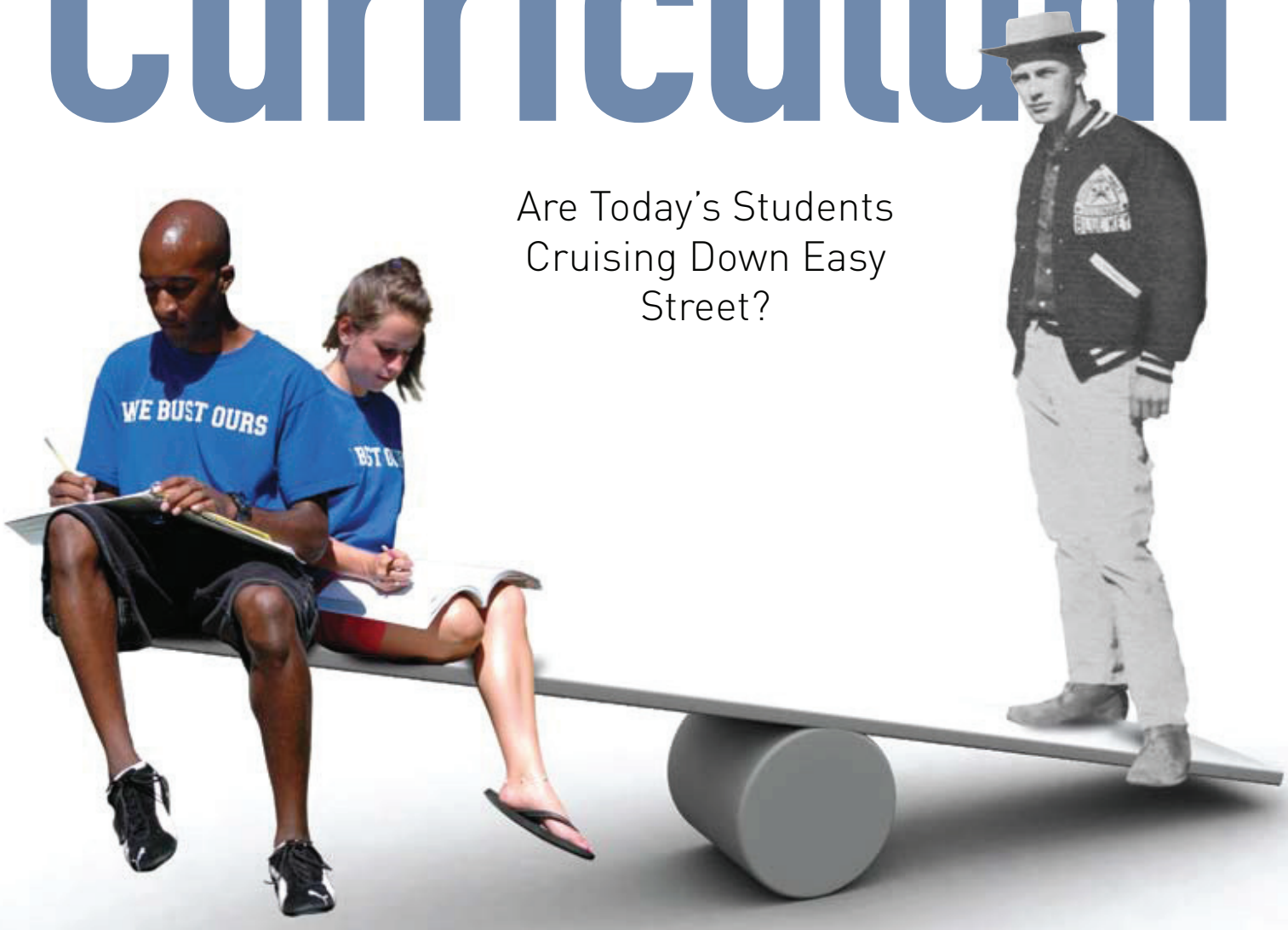


Marv Kay

The Mines Curriculum

By Larry Borrowsky

Are Today's Students Cruising Down Easy Street?



Ralph Baird knew the School of Mines was going to be a challenge from the moment he arrived for his admissions interview in the spring of 1967.

"I took the bus out from the airport," says Baird '71, "and I got off downtown and called up to the admissions office to tell them I'd arrived. At every other school where I interviewed, people chauffeured me around. But at Mines they just said: 'We're at the top of the hill. Look for the gold dome. We'll be waiting for you.'"

Baird had to hoof it up to Guggenheim with his heavy bags in tow. And he decided right then that Mines was the college for him. "That impressed me," he says. "I knew I'd have to work for whatever I got. I knew I'd have to earn it. And I found that attractive."

But Baird wonders whether today's undergraduates have to climb the same hills that he did. He believes the curriculum has been diluted and the workload trimmed down, costing Mines the pre-eminent position it once held. Baird cites courses that were once covered over two semesters but are now squeezed into one. He decries the reduction in required credit hours. And he regrets the phasing out of the professional degree, which was the only credential available to those entering as freshmen up until 1965. It required more than 160 credit hours (a bachelor's degree today requires around 140), and was, in essence, a bachelor's degree plus a professional master's degree.

"The challenge that Mines offered 40 years ago doesn't exist today," says Baird, founder and owner of Houston-based Baird Petrophysical International. "When I was going to school, you were lucky to survive. It was impossible to complete all the coursework because there was so much to do."

"People were taking 18 to 21 hours a semester," adds Richard Jolk '78, a mining consultant who holds a doctorate from Mines, in addition to a bachelor's and two masters' degrees. "It was a very demanding workload. The average GPA was only a 2.7 or 2.6. At CU, the average GPA was a 3.1, but those students got out with only 120 credit hours or so, while we were getting out with about 150. They had a much more comfortable time of it than we did."

Does Mines pose the same cut-above challenge it used to? Baird and Jolk are not the only ones asking the question. Having seen the credit hours required for graduation drop over the years, some alumni wonder whether their degrees are being devalued. In addition, faculty and administrators are concerned about maintaining standards, participating in the kind of self-examination that has proliferated across scientific disciplines in recent years. The rapid increase of technological expertise in India, China and other rising economies has stiffened competition, and the question of whether U.S. institutions are adequately preparing today's students for tomorrow's challenges is critical.

Cathy Skokan '70, MS '72, PhD '75, an associate professor of engineering who has taught on campus for 32 years, has witnessed the evolution of Mines' curriculum first-hand and points out that when you stack the school up against other institutions, it remains a very stiff challenge. "While the typical engineering undergraduate averages 12 to 15 hours a semester, our students take 15 to 18 hours a semester," notes Skokan, who in 1974 became the first woman to earn a doctorate from Mines. "Some of them juggle 20 to 21 hours of academic credit in a semester. Our students know how to work."

"That's certainly been true in my case," says Adam Smiley, a senior engineering student. "Every semester I've been here, I've carried 17 to 18.5 credit hours. That translates to between 21 and 23 hours of actual class time—and for every hour of class, I usually spend 2 hours outside of class on homework, lab reports, that sort of thing." In addition, Smiley works part-time (he's held as many as three jobs at once). He also heads up the campus chapter of the Society of American Military Engineers.

In raw numerical terms, today's Mines students don't have to log as

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many credit hours as the undergraduates of 30 years ago. A Mining degree earned in 1978 required 148 credit hours; the same degree today requires 136. But some argue that this does not necessarily translate into a less rigorous intellectual challenge.

"We need to think about what can be accomplished in one credit hour in terms that relate to how we teach," says Provost Nigel Middleton. "The calculus and differential equations sequence that took us 20 credit hours to cover in the 1950s is covered in 15 today. Academically and intellectually, we cover the same content and teach the same concepts. It's just that we can pack more material into today's credit hour than we could in the 1960s."

How is that possible? In part, it's a function of technology. Forty years ago, students spent a fair amount of their course time calculating complex problems on paper and using slide-rules. Today's students can make those same calculations in seconds via a calculator or computer.

"That's a real powerful difference," says Skokan. "Our students still do some hand calculations, but only enough to master the basic concepts. They can move beyond that very rapidly and get to a deeper level of analysis and problem-solving. You learn the same material, but much more efficiently."

"Computers enable us to cover quite a lot more ground, and show a lot more complicated circumstances and realistic situations, than we could in a pencil-paper environment," adds Middleton. "Consider a course such as thermodynamics. You can do some extraordinary computational simulations and visualizations that relate, for example, to fuel combustion in a modern jet turbine. The simulated engine in the experiment is driven by the underlying science and thermodynamic laws that the students are drilled in anyway. But the opportunity to manipulate and explore the phenomena that derive from that science is exhilarating in a learning environment; I think it's been a multiplier."

A multiplier that cuts both ways: While it increases the educational yield, there's sweat equity students have to invest on the front end. Although students who come to Mines today are very tech-savvy on admission, once here, they have to master specialized computer-aided design (CAD) and computer-aided engineering (CAE) programs, adding elements to the undergraduate workload that didn't exist 20 or 30 years ago.

"If you're talking about seat time, students do spend less time in the classroom than they used to," says Barbara Olds, associate provost for educational innovation. "But if you're talking about intellectual rigor, nothing has been lost. In some respects, it's tougher—science is more complex than ever, and as a result our students have to master some skills and concepts that weren't taught a generation or two ago."

As in the past, Mines students today devote considerably more out-of-class study time than their contemporaries at other institutions. The most recent National Survey of Student Engagement, which polls students from hundreds of institutions around the country, found that a degree from Mines involves considerably more study time than its peer institutions.

One course that bumps up out-of-class study time is EPICS: a two-year design sequence that gives first- and second-year students practical, hands-on design experience. Working in teams, students make oral and written presentations, handle budgets, evaluate materials, meet project deadlines, and practice other skills they'll eventually need in the workplace. These assignments require dozens of hours of work outside the classroom.

"EPICS was one of the first programs of its type nationally," Olds observes. "When we launched it in 1983, there were only two or three other schools in the country that had anything similar. Today you'll find something like it at nearly every engineering school."

To some, these innovations are nothing to celebrate. In fact, they are seen as part of the problem. "The curriculum has become very 'flavor of the day,'" says Jolk. "Mines has this biotechnology program now [Bioengineering in Life Sciences]. We have mineral economics. We have humanitarian engineering. Mines once had a specialized niche, and it excelled within that."

"Mines is a natural resources school," adds Baird. "But it has broadened its curriculum so much that it's no longer a natural resources school. Anything outside of a natural resources major is a token department. They should be supportive of the main goal of the school."

"The latest strategic plan focuses on earth, energy, materials and the environment—that's very much within the school's traditional areas," counters Olds. "I would argue the school hasn't diluted its mission, but rather is adapting that traditional mission to the 21st century."

In part, curriculum changes have been mandated by accrediting agencies, such as ABET. Nontechnical requirements have been added in recent decades that must be addressed in undergraduate curricula. Perhaps more important, adaptation has also come in response to market pressure: employers have made it clear that they want engineering schools to produce well-rounded graduates.

"When you talk to a recruiter," says Middleton, "they want students who can think on their feet, who are skilled in communications, who can behave professionally in the boardroom, who understand cultures around the world and are comfortable going to Singapore or Australia. We hear that from recruiters, so we have to address that. It's got to be a part of the experience we provide at Mines, in addition to the mainstream science and engineering of their majors."

Bruce Clemens '78, a professor of materials science and engineering at Stanford, points out that while some things change over time, there are curriculum fundamentals that remain constant. "You want to give students lots of practice at solving hard problems," he

says. “And you want to give them the intellectual agility to tackle anything, and the confidence that they can do it.” Clemens’ own experience suggests the school continues to meet this obligation—he describes the Mines graduate working in his Palo Alto lab as “the best student in my group.”

And if demand for Mines grads is a good reflection of how well students are being prepared for the workplace, then the school is still at the top of its game: job placement rates for 2007 grads are 99 percent for bachelors’ degrees, 100 percent for masters’ and 98 percent for doctorates. The 2008 fall Career Day was attended by more than 200 employers, and had a waitlist half as large. After the spring 2008 Career Fair, a Northrop Grumman recruiter wrote, “CSM has the best technical students in the region. Our managers are always impressed with the caliber of interns and college hires that we have on staff.” Meghan O’Connell of Olsson Associates echoed these sentiments: “Not only are the students top-notch technically, but they are also well-prepared in important business aspects such as communication, relationship-building and teamwork.”

Adam Smiley—the electrical engineering major previously mentioned—works periodically for the Foundation’s call center, helping to fundraise for the school. Naturally he ends up talking with a lot of alumni, and once in awhile he hears comments about how easy today’s students supposedly have it. But he doesn’t take these comments to heart. “I just think they don’t know what’s expected of students right now,” he says. “I don’t know what their experience was like; I wasn’t there. But by the same token, they can’t really understand what a student goes through today, because they’re not here.”

Speaking with both Smiley and Baird, it’s clear that they both take pride in their education, and that they have both worked hard to earn it. As he climbed the hill to Guggenheim in the mid-sixties, Baird sensed that Mines would be a challenge—and he was right. Similarly, students today arrive on campus with the expectation that Mines is a difficult school, and their experience bears this out. So while much has changed, it might just be that the hallmarks of a Mines education are as indelibly imprinted on the school’s 21st century graduates as they ever have been, and those who descend the hill today with degree in hand have a great deal in common with those who have gone before. M

From left: Tyler Curtis, freshman; Stephanie Biagiotto, freshman; Aaron Swift, junior