THE ROBOTS ARE COMING!
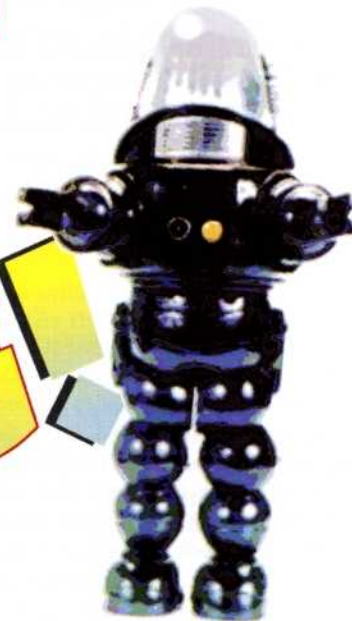
And their mission is to capture the minds and imaginations of Oklahoma's students.

BY ROBERT FERRIER

photos by Robert Taylor

Imagine a carpeted room strewn with small, wheeled robots made from bright Lego blocks. Near the front of the room, posed at a table, the keepers of the robotics kingdom smile at a photographer.

At the camera's flash, a yellow, two-wheeled Cye-bot rolls toward the center of the room. An October cricket scurries across the carpet, escaping robotic hit-and-run. A magic robot? More likely a timed motor, or light sensors reacting to the camera flash. Strange devices named "Scarecrow," "Alfred" and "Tooth" lurk on tables along the walls.

Welcome to the KISS Institute for Practical Robotics (KIPR), where a couple's dreams and hard work reach out to capture young minds.

Robots will impact our daily lives, believes David P. Miller, a leader in artificial intelligence who joined the University of Oklahoma College of Engineering in August as Wilkonson Professor of Intelligent Systems. Designer of NASA's Mars Pathfinder Rover, a mobile robot operating for the first time on an extraterrestrial surface, Miller conducts research in automated planning, robotics and communications with automated systems.

In addition to his faculty assignments, he and his wife, Cathryne Stein, have relocated the KISS ("Keep It Simple, Stupid") Institute from Reston, Virginia, to Norman. Miller is technical director, and Stein is president.

The nonprofit institute, located in OU's new business incubator in Lindsey Square Business Park, conducts research and educational outreach programs to interest children in engineering and computer programming. The institute also will serve as a research environment for OU students and as a platform for spin-off businesses resulting from University technology.

"We moved to OU for the opportunity to grow and because of the research climate," Miller says. "The institute is, in effect, a 3,000-square-foot robotics research laboratory of the College of Engineering. If we can interest middle school and high school students in programming, we can begin to solve a critical shortage in computer scientists as well as help bring businesses into Oklahoma. We want Norman and OU thought of as the robotics capital of the world."

Currently funded by Miller's "startup" money from the College of Engineering, government and industry grants, and private donations, KIPR seeks to capture students' interest through several innovative approaches. The Institute's Botball Program offers middle and high school students across the nation hands-on experience in designing, building and programming a mobile robot. KIPR personnel conduct a three-day tutorial for high school lead teachers and sponsor organizations (often local businesses or industry). After KIPR gives robot kits to the teachers, student teams design and build an entry in a regional Botball tournament.

Students program the robots using a language called "C." These small, lightweight robots perform on inexpensive game tables. In tournaments, the robots maneuver table tennis balls while competing against other teams' robots. The robots operate totally under programmed instructions based on feedback from sensors, with no remote control. Robotic collisions abound; everyone learns and has fun.

"I've been told that these tournaments have changed lives," says Stein. "A student in California had been poorly motivated, was abusing alcohol and was anti-social in large group settings. Through Botball, he developed an interest in robotics and discovered hidden talents in engineering and programming. Teachers said his attitude toward school improved."

Botball costs about $2,000 per team, usually paid by major donors or local sponsors. The registration fee covers the tutorial for lead teachers and mentors, all the robotics materials, software and participation in the tournament. Stein and Miller seek enough funding for the Botball program so that all schools who wish to participate may do so. Organizations and individuals sponsoring the program may receive national exposure, and they will be in good company; NASA centers have funded teams, hosted tournaments and provided displays.

The game not only exposes students to high-tech career fields, but also teaches students—through hands-on experience—how the tools of math and science are useful in creating solutions. Businesses provide money because they see their economic future in the students.

OU student Justin Morgan makes adjustments to one of the robot participants in a Botball tournament. The Botball program focuses on middle and high school students, offering them hands-on experience in designing, building and programming a mobile robot.

Schools must show strong interest in the program by providing a lead teacher to act as contact person. An Oklahoma Regional Teachers' Tutorial and Botball Kick-off was held January 7-9, with the first state tournament scheduled for February 19, both in the OU Field House.

Miller and Stein received enthusiastic responses after contacting schools in Norman and surrounding communi-

ties about their programs. They have generated interest among OU students, who participate as mentors.

"I love working here," says Eric Wainright, a Cupertino, California, junior in computer engineering. "When I see students' eyes light up as they discover the fun of robotics, I know I've chosen the right career. After graduation I plan to work in the Silicon Valley area of California, then get an MBA and start my own company. Eventually, I'll teach children."

Gavin Palfreyman, a Tulsa junior majoring in computer engineering, believes K-12 teachers have fallen behind in computer science curricula. "My mother teaches computer science in K-8. For the past four years she's taken computer science classes at a Tulsa community college. However, in my high school—except for a couple of exceptions—most of the staff teach as they have in the past. We need new ideas and methods in schools; they're falling behind in computer science."

Jennie Mast, a Lake Jackson, Texas, sophomore in mechanical engineering, enjoyed making Lego structures as a child. "My dad works as an engineer, and I was always putting things together," she says. "When Eric told me about the institute, I couldn't wait to get here. We never studied robots in high school, and this is my chance to learn something important for our future while helping the Institute get started."

Miller surprised Mast when he showed her a room filled with tracked wheelchairs. He explained that a brewery company had awarded a small engineering firm a five-year grant to design and build robotic wheelchairs capable of climbing stairs. As the company neared completion of the chair, the grant term expired. The brewery refused an extension, and the company folded, dooming the wheelchairs to crushing machines. Enter "white knight" Miller, who heard about the story and convinced another company to rescue the wheelchairs and deliver them to KIPR for his TinMan research.

Engineering Professor David Miller, a leading authority in artificial intelligence, demonstrates the stair-climbing ability of robotic wheelchairs, part of the KIPR's TinMan research. The chairs are designed for people lacking the fine motor control or full vision to safely operate a standard power wheelchair. A supplementary controller also allows the chair to sense obstacles and maneuver around them with little input from the user.

The TinMan program typifies Miller's career philosophy: robotics should help society. Some people lacking fine motor control or full vision cannot safely operate a standard power wheelchair. Miller has designed a supplementary wheelchair controller, allowing the chair to sense obstacles and maneuver around them with little input from the user.

Miller thinks the emergence of robotics raises issues beyond technology. "Robotics will stimulate the economy by streamlining manufacturing. Global economies will change as people perform different tasks. Society will ask: What is the nature of life? Of intelligence? Do robots have 'rights'? To illustrate this issue, a film series will show a 'Star Trek' episode in which a cyberneticist wants to disassemble Data, the android. Data refuses. The cyberneticist attempts to have the android declared 'property,' thus eliminating his free choice. Data goes on trial to determine if he is 'property,' or a Star Fleet member."

Miller believes that eventually in our society, someone will try to turn off a machine, and the machine will object. What differentiates a machine from a human? The film series and panel discussions will address these questions.

After a distinguished career at NASA, the Yale graduate now lives his dream of implementing robotics at every level of education. "Robotics offers a perfect teaching tool," Miller says. "I could use robotics to teach post-Renaissance history of the world; since that period, people have been inventing machines to perform human tasks.

"As another example, robotics relates to language studies. Programmers must understand human language better than anyone to design language-interactive machines. We're educating the public that robotics transcends much of society, not just a technological niche."

Miller's presence has impacted the College of Engineering curriculum. In the spring semester, he will teach a design and practicum course in mechanical engineering using robots from KIPR. Undergraduate teams will build a library

robot capable of searching the stacks for misshelved books. Also, Miller will teach a control lab that will give students hands-on experience with feedback and robot motor control.

Miller lists several goals for KIPR: "Enhance secondary education math and science instruction by establishing robotics in the K-12 curriculum. Use KIPR technology to build the College of Engineering's curricula in intelligent systems, an area of critical need in the field. Gain public acceptance of robotics as a workforce multiplier, not a threat to jobs. Improve Oklahoma's economy through 'spin-off' companies resulting from technology developed at OU."

When she graduated from the University of Northern Colorado with a B.A. in psychology in 1979, Cathryne Stein never envisioned her future role as founder and director of an organization championing robotics as an educational tool. After a one-year graduate fellowship in clinical psychology at the University of Kansas, she traveled to New York to pursue a music career.

"I loved music, and I discovered that although I enjoyed helping people, the field of clinical psychology just didn't make my heart sing," she says.

On the way to New York, she visited her sister, who was a first-year graduate student at Yale, studying artificial intelligence—as was David at the time. Cathryne was intrigued.

"Anyone who has studied psychology sees common ground in artificial intelligence," she says. "David and I fell in love, married and had a son. One day when we took robots into Bob's first-grade classroom, we were amazed at how the machines grabbed the kids' attention. In fact, one boy who had been somewhat of a bully and fairly disinterested in school suddenly seemed fascinated. He even designed some experiments. The teacher said this boy rarely participated in class activity."

When the couple visited other classrooms, students showed the same interest. "At that point, David and I knew that when you put robots in a classroom, they create excitement and learning," she says. "We had to find a way to continue this effort."

Stein envisions that Norman students—and their teachers—will take the lead in spreading the Botball program and its benefits throughout the state. A lead teacher or parent at each school will organize a Botball team. These students' interest—and rising performance in mathematics and science

courses—will prove to parents, school administrators and business leaders the validity of robotics as a subject that engages students and enhances curriculum.

David worked on NASA's Mars Rover project with Donna Shirley, an OU graduate recently named assistant dean for advanced program development in the College of Engineering. Shirley, who had learned of OU's interest in establishing an intelligent systems curriculum, informed W. P. "Skip" Porter, dean of engineering and University vice president for technology development, that Miller and Stein might be receptive to an academic environment where they could pursue their dreams. Porter began negotiations, leading to Miller's faculty appointment last summer.

The engineering dean foresees that the couple's work at KIPR and Miller's teaching and research will benefit the college immediately. "Today's knowledge-based economy demands multidisciplinary problem solving," Porter says. "In the past, colleges of engineering have structured their offerings as single discipline courses. At OU we want to impress upon our engineering students the importance of working in interdisciplinary teams. KIPR—with its background in robotics—fits that goal.

Pictured from left are Cathryne Stein and David Miller, who were looking for an academic environment to pursue their research and education goals; Dean W. P. "Skip" Porter, who was interested in establishing an intelligent systems curriculum; and former NASA project manager Donna Shirley, who brought them all together.

"David Miller's NASA work on the Rover typifies the interdisciplinary team concept. How was the vehicle to be powered? How would it be steered? How could the computer be programmed to accomplish all the tasks? These problems cut across many disciplines. The institute offers OU students a prototype laboratory for cross-disciplinary studies. Beyond the academic advantages to the college, we're excited that KIPR makes mathematics and science fun for elementary students across the country."

Participating in Botball will encourage more female students to enter engineering, Porter predicts. "KIPR's programs will lead more Donna Shirleys into engineering. Donna paved the way. OU faculty told her, 'Women don't study engineering.' Yet Donna proved them wrong by graduating from OU and excelling as an engineer at NASA's Jet Propulsion Laboratory."

Porter refuses to let Oklahoma's potential Donna Shirleys—or David Millers and Cathryne Steins—slip away. And he remains convinced that the KIPR team and their intriguing robots can attract top students to enter a field that will impact our lives daily.