

Missouri Shamrock

The UMC College of Engineering Student Magazine

OCTOBER 1980

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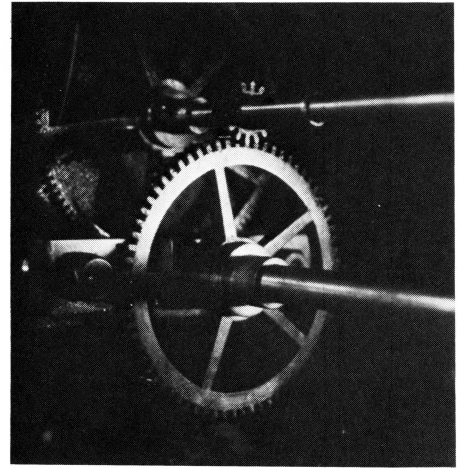
 **HEWLETT
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The October cover details the inner mechanism of the Memorial Union Clock. Pictured are the gears that have measured time for over forty years. Photo by Rene Chouteau.

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Foremost, the *Missouri Shamrock* gratefully acknowledges its advisor, Ms. Margaret Kraeuchi, Director, Engineering Communications.

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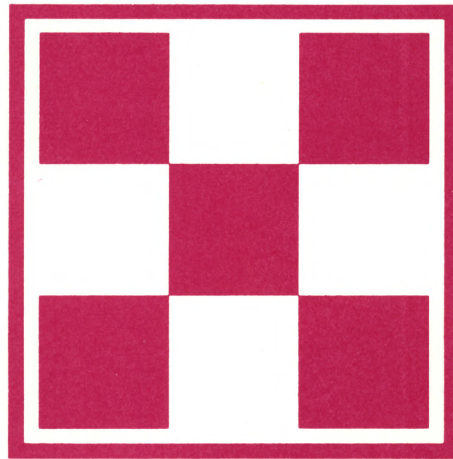
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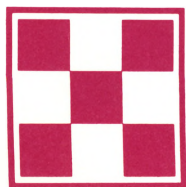
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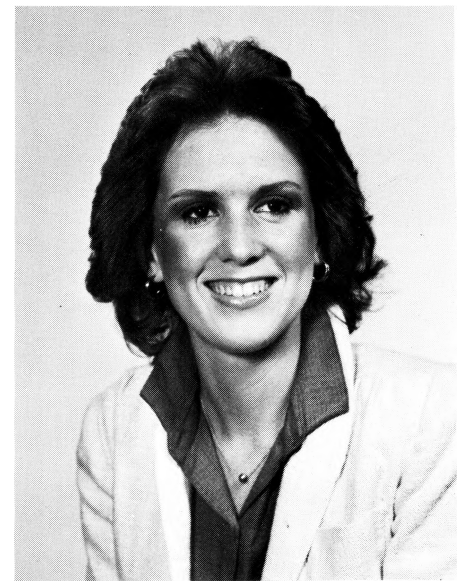
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Remembering Engineers' Week '80

by Laurel Vogel



Sara Franklin is the 1980 Engineering Queen. Sara is from Independence Mo., and attended Truman High School. Although her interests are diverse, she is pursuing a career in Child and Family Development, as well as in Early Education. Sara is beginning her third year here at UMC and is a member of Alpha Delta Pi sorority. Being crowned Engineering Queen was one of the biggest thrills of Sara's college career, but she emphasizes that the most rewarding aspect of the honor was the engineers she met and the friendships she began.



Vicki Gentry



Amy Hagedorn



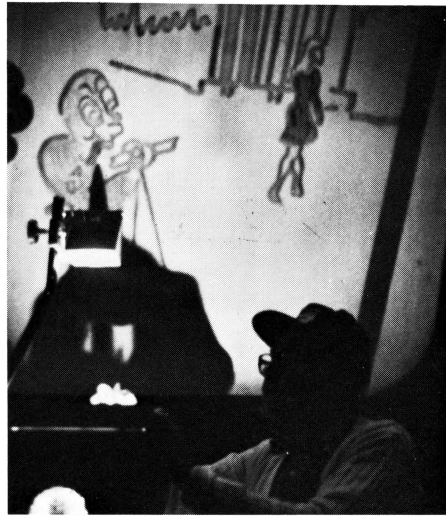
Jean Smith



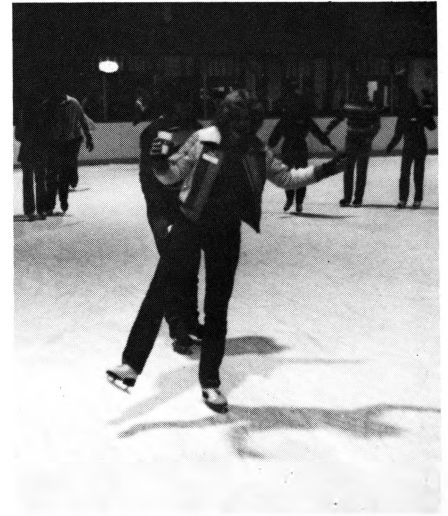
Cozey Venable



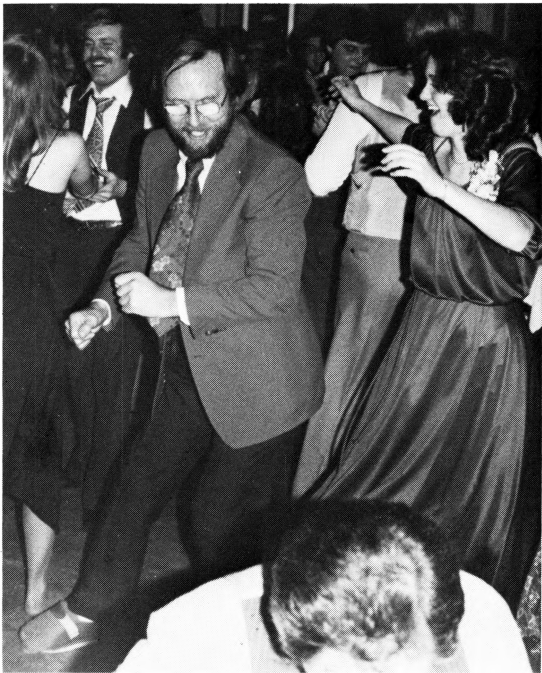
The Dean Morgan tradition



Faculty Fun and Frolics proves to be an educational experience



Grace Ann hams it up (or is it, tries not to fall down?)



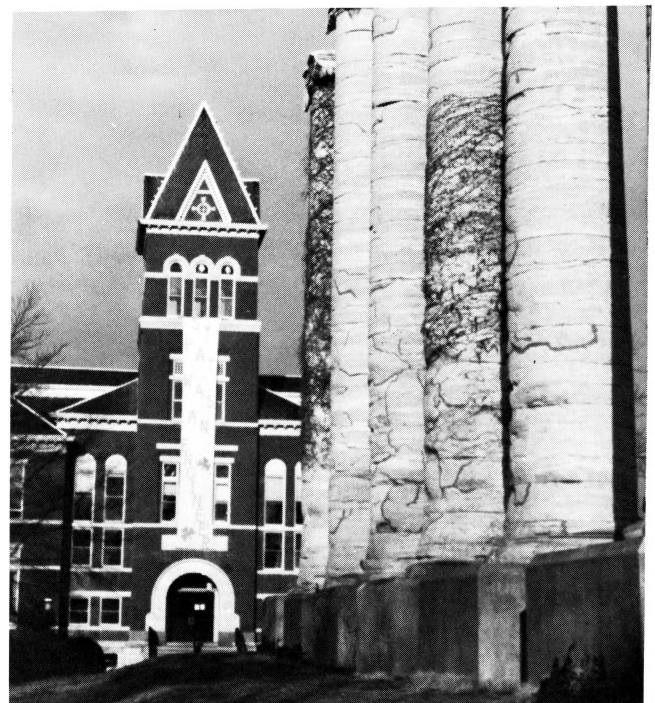
GET DOWN DOC!!



Students and faculty enjoy a casual gathering at the Chancellor's home for the Green Tea.



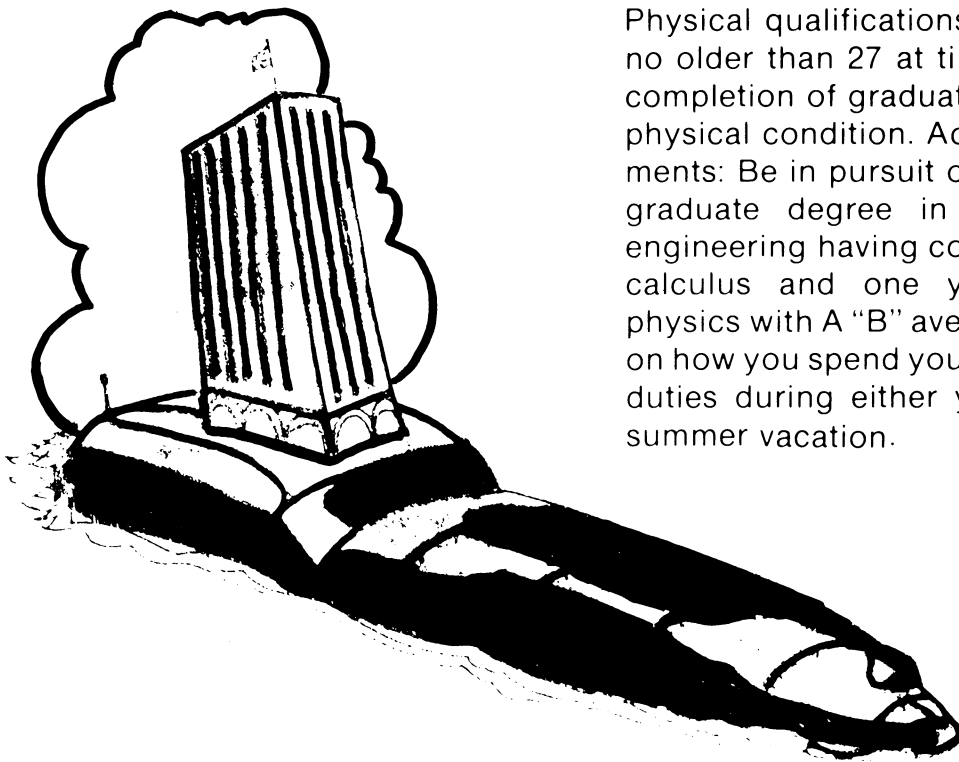
Keith really captures the thrill of the fifties



Engineers' Week is as much a part of Mizzou as the columns

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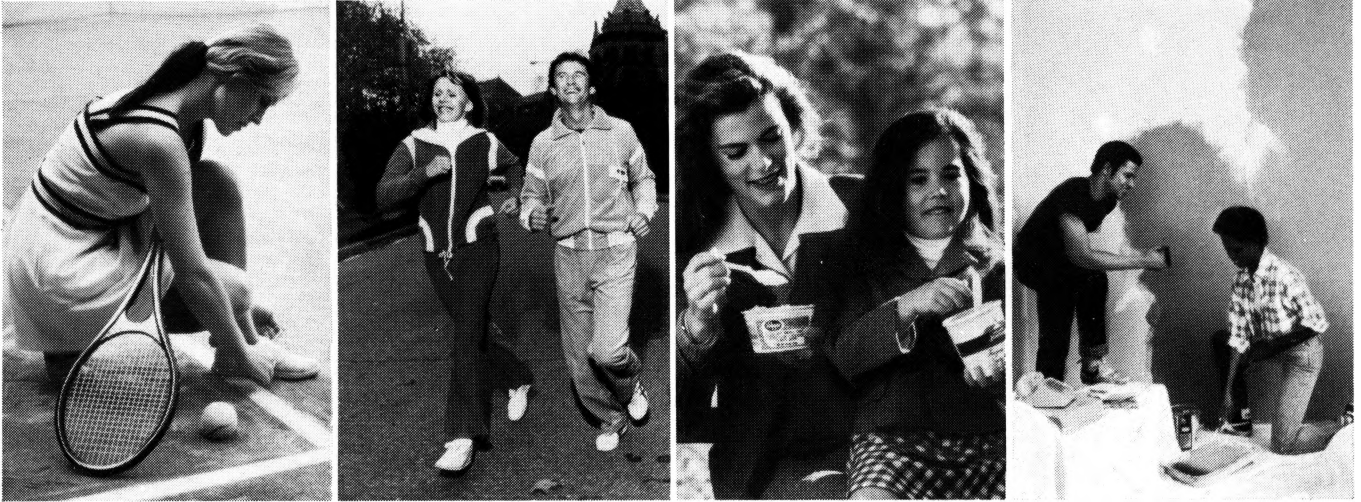
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Engineer With Heart

text and photos by Judy Stein

(Ed. note: Special thanks to Judy Stein, author of this sensitive story. Engineer With Heart has also appeared in the Engineering Newsletter and Mizzou Monthly.)

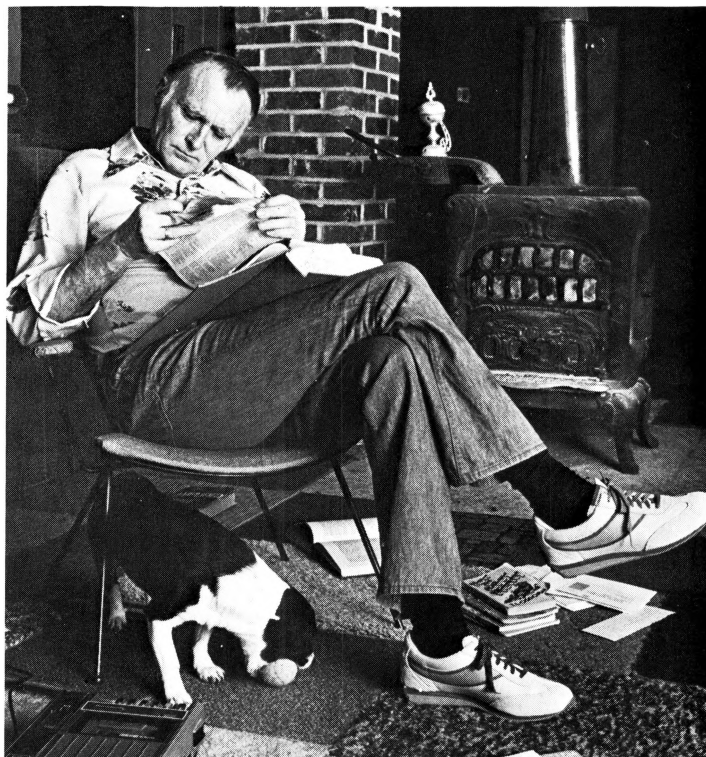
It was five o'clock. John Uhlig was leaving work when a boy in a wheelchair was brought into the shop. The chair had broken and wouldn't move in any direction. John was asked if he could help. "Surely there's nothing in a wheelchair I can't fix very quick," John thought, not knowing there were about 60 transistors inside. Nine hours later, after John had traced each transistor, he found the one causing the trouble and the chair was fixed. He did not charge for his time. "Wheelchair people have a grapevine about as good as truck drivers," John said. Before he knew it, he was fixing wheelchairs during his lunch hours and after

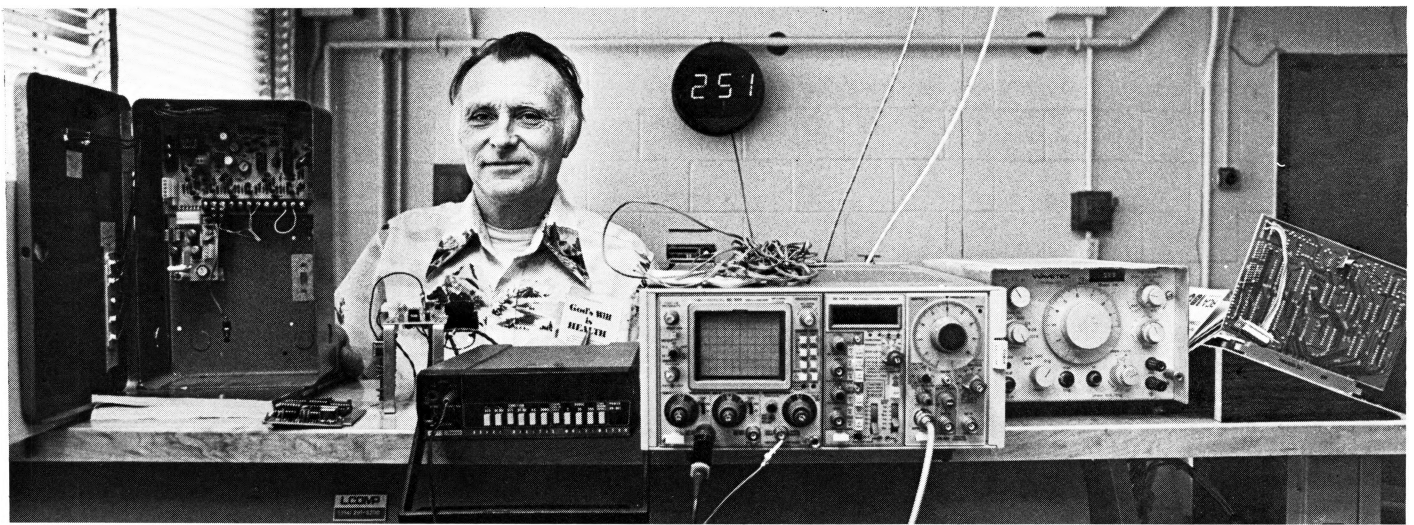
work using make-shift parts and a hand-drawn schematic. "If I hadn't been able to repair the chairs," John said, "it would have been three months or more for these people to send them to the manufacturer in California. That would have cost a semester of school."

So John repaired chairs. That was fifteen years ago when John was operating a one-man, one-room electronics shop for the College of Engineering. Today, he's supervisor of a seven-man, greatly expanded and modernized electronics lab that does research, design and repair work for the University. The wheelchair repair, now a part of the shop function, is done in a separate room—this time with a printed schematic, standardized parts, and a manufacturer's authorized repair service.

John's willingness to give his time and knowledge in all situations, has brought him respect and support. The seven employees working for John feel more than respect for him. They say they wouldn't want to work any other place. The atmosphere is free and loose. There is a friendly joking that flies back and forth among everyone. John encourages the men to make their own decisions and work on their own, yet he always seems to know when they need his help. He knows when to push—and he always does it gently. "John very seldom says anything against anybody, he just listens," said Lynn Ash, a five-year employee. "If you have any problem, nine times out of ten, John will solve it for you." Michael Anderson, another employee, said John cares not only about the shop and its growth, but the growth of the people in it.

John's caring extends beyond his





As part of seventeen years' work in the University's electronics lab, John Uhlig, 52, designed and patented a centrally controlled digital clock system.

work situation. When he's not in the electronics lab, he's teaching the Bible. He holds classes on his lunch hours, on Thursday evenings in his home, on Friday evenings at the Moberly prison, and on Sundays at the church. On a "free" evening, John might minister to the sick in the hospitals or referee a Missouri swimming meet with the timer and starter he designed. John's time at home is spent visiting with his son and daughter, playing with his dog, lifting weights and studying the Bible. A late-night phone call is not unusual. John might stay awake for hours counseling someone who needs a sympathetic ear.

Lynn and Michael don't know how John keeps the pace—he always has time for everyone. They think his religious beliefs give him more

drive than the normal person. "My most vital interest is my Christian work," John said. "It's a way of life, not a one-day-a-week affair."

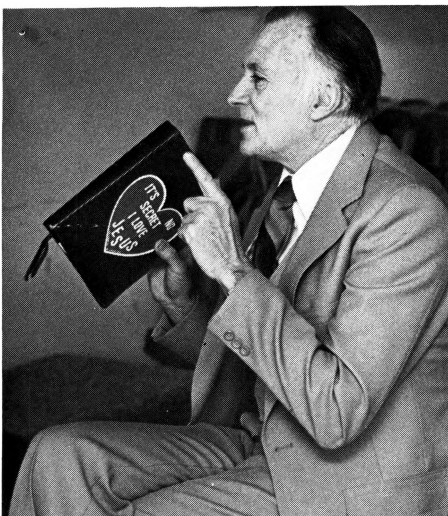
What people admire about John is he practices what he preaches. A woman walks into the office with an underwater audio speaker, water-logged and irreparable. The syn-

chronized swimming group using the speaker had no money to buy new ones. John designs and builds his own underwater speaker and installs it for the group on his own time.

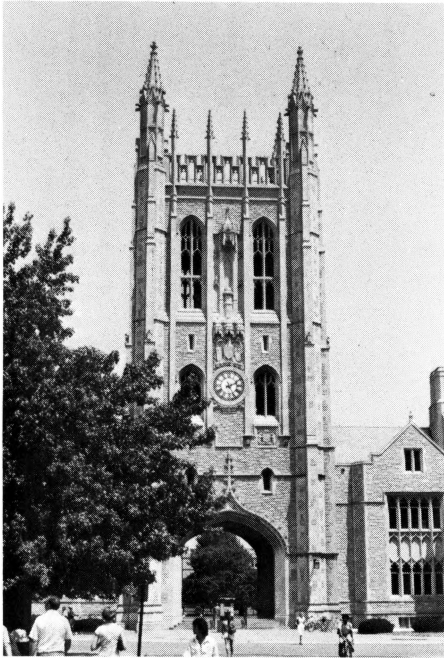
"If I can help someone, I'm going to," John said. "I'm here on this earth for that purpose."



John Uhlig gets satisfaction from a job well done. At work, his job is supervising repair and design work in the electronics lab. After work, John sees his job as "transforming people's lives from nothing to something" through Christianity. Using over a thousand religious tapes, John spends long hours studying the Bible at home. Then he goes out to share his knowledge. From seventh graders at the local church, to criminals in a prison chapel, to the sick in the hospitals, John spends his free time helping others.



Does Anyone Really Know



Taken for granted in today's society, the clock involves some amazing technological advancements. Clocks have existed at least since the 1300's; that is, over three centuries before Newton and his famed laws of motion. Yet man, at this time, had already invented a mechanism with a weight driven power supply and a set of handmade gears. A recent estimation has placed these ancient timekeepers within an accuracy of 10 to 20 minutes per day. Originally, these clocks were large turret clocks driven by a falling weight that periodically needed to be hoisted back to its starting position. The constant force of gravity provided an efficient, unfluctuating power source, which was only interrupted during the rewinding process. A train of engaging gears then translated the power to the hands of the dial, while another train of gears operated the striking mechanism. The last wheel of this set of gears, called the escape wheel, forms the single most important factor of timekeeping: the ability to release the stored energy at a rate that coincides with the passage of time. Without the loading effect of an escapement, the weights would fall freely at 32 ft/sec—a rate that would strip the gears and possibly do irreparable damage to the clock casing. Throughout the history of clockwork, the escape mechanism has been the prime site of attention and has inspired countless, though varied devices.

Today, the giant tower clocks found in churches and universities are still patterned after their early predecessors and the Memorial

Union Clock serves as a good example. Although the weights of the Memorial Clock are now rewound by a small electric motor, most of the mechanical parts of the clock closely resemble the earlier models of clockwork. A maintaining power supplied during the rewinding process avoids any momentary loss of power and is one such small mechanical improvement. The major variation from the past lies in the Clock's escapement. The Union's particular version, designed by an English lawyer in 1852, is the same gravity escapement used for Big Ben in the London Tower. The system consists of a pendulum that runs off the escape wheel through an intermediate system. The ideal pendulum of resonant length will swing indefinitely, but in the actual system losses due to friction are overcome by an impulse created from the turning of the escape wheel. In other words, the original power source is what

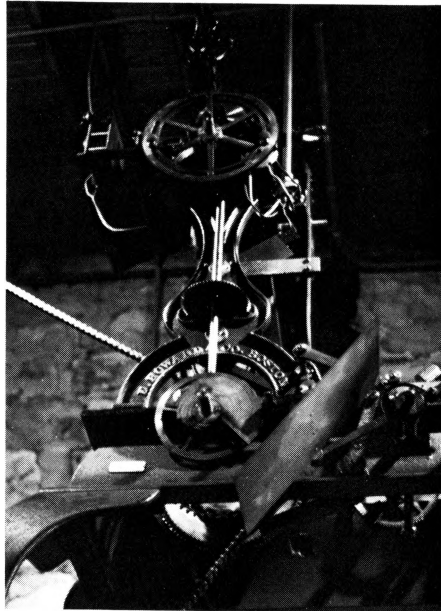


What Time It Is?

by Michelle Morris

keeps the pendulum in motion and the swing of the pendulum is what periodically released the stored energy. Consequently, variations in the power supply will effect the consistency of the timepiece and thus the need for the intermediate system of the gravity escapement. A weighted lever, acting as a go between, is raised by each escape wheel tooth and released by the swing of the pendulum. The lever then falls back into place under the constant force of gravity, supplying an even regulation of power and therefore *time*.

The Union Clock though sturdy in design has had its own special problems. Upon installation in 1936, the precision machined parts began to slow with the winter and eventually froze. It was found the clock needed a constant temperature of 50°F. This initial exposure to fluctuating temperatures may have had an effect on a major breakdown that occurred in 1950, where the pendulum itself fractured. Since that time, an electrical system has been added to release the weighted lever of the gravity escapement according to the University master clock. Other minor stoppages have included improper cleaning and lubrication of the brass gears and the loss of a chime due to a loose bolt. But for the most part Mizzou's timekeeper has accurately served this campus for 44 years, a truly impressive amount of time. When will it all stop? Not in this lifetime. Big Ben is ticking away on its 121st year of operation. If that is any indication, then 80 years from now M.U. students will still know what time it is.



photos by Rene Chouteau

In Spientia Ambulate Tempus Rediments

The Memorial Union, with its English Gothic architecture, still turns the heads of those who pass by. The Union, dedicated to the students of the University of Missouri who lost their lives in World War I, stand 143 feet from the ground floor to the highest spire. Work on the tower began in 1923, and was completed three years later.

Of special engineering interest is the clock and bell system housed inside the Memorial Union Tower. In

1936 Charles Baird presented five bells and the clock to the University. However, in 1950 due to control problems, the original pendulum had to be replaced by a mechanical weight system with electrical controls.

Inscribed around the lavender face of the clock is the Latin phrase: "In Spientia Ambulate Tempus Rediments," or walk in wisdom, redeeming the time.

Conversation

by Dave Wilkerson

photos by Rene Chouteau



Assistant Dean Jack Morgan

The demands of engineering school can cause many students to have second thoughts about the profession. In this issue, CONVERSATION talks with Dean Jack Morgan and several upperclassmen to find out what can cause a student to quit engineering and what steps he or she can take to be successful in the program.

CONVERSATION: *What are some of the factors that can contribute to a person quitting engineering school?*

DEAN MORGAN: One major reason qualified students don't succeed is because they are unable to make a good social-psychological adjustment from their home and high school to the university environment. By qualified students I mean that their test scores and high school grades show that they have the potential to succeed in engineering at Mizzou.

Another reason is that students don't have a good feel for the demands of university level courses until they get into them. They may have done well in math and science in high school, but often patience is needed to learn how to cope with the new demands of college courses. Physics and calculus are difficult for most people and often the relationship of these courses to engineering cannot be seen until students begin taking main line engineering courses in their junior year. If students lack motivation, they may lose interest because of physics or calculus, without ever taking courses in their chosen field of engineering.

Many students also do not take advantage of the free tutoring and other self-study helps offered. They simply don't utilize the services that are available to help them succeed.

A freshman who begins to experience a combination of these factors can get discouraged and if so, is likely to quit.

CONVERSATION: *What advice would you give to students who are discouraged about Engineering school?*

DEAN MORGAN: I think most students, regardless of ability, that come to Mizzou as a freshman have some worry or anxiety as to how well they are going to do in engineering. Only after a few tests, or sometimes a few semesters will this anxiety begin to fade. So I think that patience is very important.

If a student is having academic difficulties, he or she should seek out help to improve their study skills. For example, one student told me that the only way she made it

through engineering was to do her homework the same day that it was assigned.

A student should also get tutoring help when it is needed. Studying with others in the same courses can also be helpful because problems can be approached as a group. But whatever the problem, you've got to help yourself.

In adjusting to university life it might help a person to become a participating member of some meaningful campus organization. It doesn't have to be engineering related because the important thing is to establish a base of friends to share problems or experience with.

CONVERSATION next interviewed several students to get their views. *The question asked was, "What beliefs or ideas have helped you to make it through engineering school so far?"*

LARRY KREMER, SR. EE: I work on electronic projects on my own time to give me insight to the knowledge I'm obtaining in classes. It's easy to get lost in the theory unless you see some of the practical applications.

CAROLE MILLER, SR. IE: I stayed in the program through lots of hard work. I've been in other fields such as Math and Computer Science and I find that I get the most satisfaction from engineering. You can't skip a class because you miss too much.

BILL MAUPIN, SR. ME: I always go to class. If I need help I go get it from the instructor, and don't put it off until it's too late. In studying for tests I rework as many problems as I can just prior to the test so that I see what mistakes I would've made on the test. I've seen enough people who have kept working, even though their grades were bad, and eventually make it. It's those who give up that don't.

STEVE GHAREEB, SR. IE: I have found that working part time forces me to be organized and keep up with my assignments. I also find that having interests other than school keeps it from getting too monotonous.

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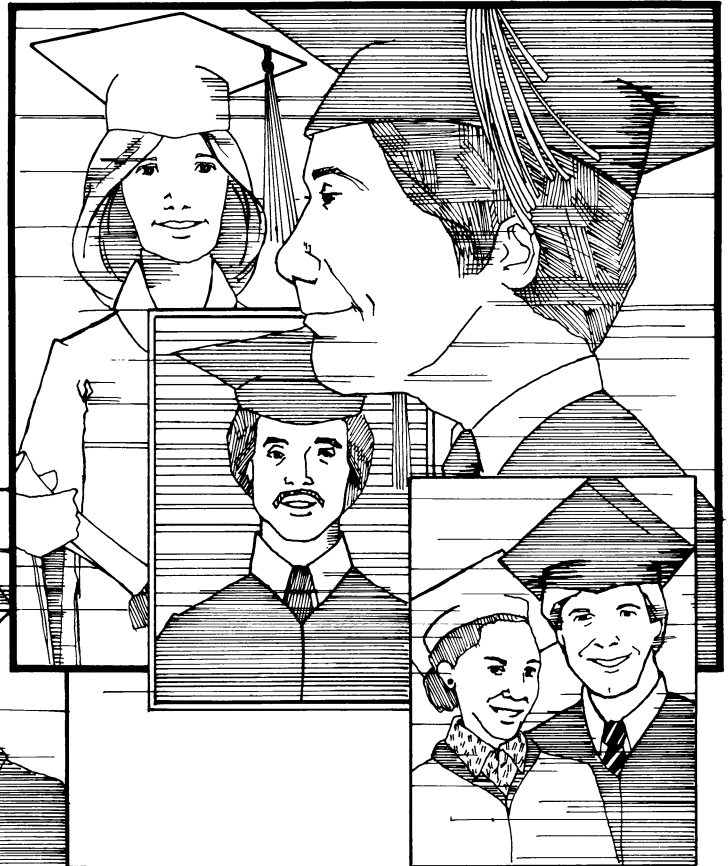
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The Making of the UMC Engineer

by Jim Bartley

Calculator-toting men and women with white shirts and hard hats portray the typical engineer. For those who are not knowledgeable about engineering, it is not as dull and narrow as the stereotype suggests. Mechanical, electrical, civil, chemical, and industrial engineering are some degrees offered. U.M.C. not only offers the highest standard of technical training, but also the availability of high quality liberal courses which are needed to develop the well rounded engineer.

The mechanical and civil engineers are to engineering what the family doctor is to medicine, a classic representation of their overall profession. Mechanical and civil engineers can often be found wearing

"... Starting salaries for BS engineering degrees averaged \$19,872."

hard-hats, looking like a "typical" engineer. Both use the laws of physics, forces, thermodynamics, and analysis of materials to accomplish their objectives. The civil engineer is often involved in the planning, design, and construction of roads, bridges, and large building projects. If an individual displayed an unusually high interest and aptitude with "tinker toys" as a child, he would probably be well suited to civil engi-

neering.

A mechanical engineer covers the design analysis and control of machine systems. He also understands the use of materials and the generation of mechanical power. Mechanical engineers are also involved extensively in the field of aviation. Without mechanical engineers, man's flight to the moon, supersonic airplanes, automobiles, power plants, and many other mechanically operated instruments would be extremely crude, and, in some cases, nonexistent.

Electrical engineering is, at present, the most opportunistic of the engineering fields. A "double E" (electrical engineer) deals with the design and development of electrical components and systems. Electrical engineers are at the forefront of a technological explosion which affects everyone. The dramatic growth of satellites and global communications, the accelerated use of electric power, and the dominating influence of the computer are benefits achieved, and more are rapidly being developed by the electrical engineer. The design and development of computers and the technological advancements in microelectronics assures a constant demand for electrical engineers in the future.

Chemical engineering could well be the hardest degree to achieve, but its graduates are also the most highly paid, because they are the most in demand. Virtually all industrial activities depend on chemistry. The

chemical engineer deals with chemical reactions, as do chemists. The separation is the "chem E" is also concerned with the planning design, and equipment specifications for all aspects of chemical plants. The chemical engineer must also deal with the economics and the environ-

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mental impact of chemical processes.

Finally, the industrial engineer uses physical laws and the principles of science in designing and developing systems which produce products or provide services. The industrial engineer is often called the efficiency engineer. He must consider both the capabilities of machines, and physiological and psychological capabilities and limitations of man. Industrial engineers are also involved in the design of entire plants and systems to control the production, inventory, and quality of large production processes. Industrial engineering is by far the most business oriented of the engineering fields, and lends itself to the possibilities of high-level management positions. At high corporate levels, the industrial engineer is concerned with plant and warehouse locations, the development of sales forecasts, the evaluation of proposals to produce new products, and making large capital expenditures to build new or improved production facilities.

The University of Missouri-Columbia (U.M.C.) offers all of the engineering disciplines described above, in addition to agricultural, nuclear, and biological engineering.

U.M.C. offers these engineering disciplines in four or five-year 126-hour curriculums. U.M.C. School of Engineering is one of the premier institutions in the U.S. Some of the factors contributing to U.M.C.'s high engineering standing are the strong technological courses which are required and the availability of quality liberal arts and humanistic classes. The high quality of liberal courses offered at U.M.C helps to develop students into "well rounded human beings" and not just "preprogrammed technical students".

The overwhelming answer is simple: money. Starting salaries for December BS engineering graduates averaged \$19,872 per year. Students received an average of four job offers. Jack Morgan, director of engineering placement, said he "could have placed a lot more students if they had been available." Morgan also predicted "engineering bachelor degree salaries would continue to climb at the rate of ten percent or more per year."

Although the statistics concerning engineering salaries are quite im-

" . . . the only degree which is interesting enough to spend four years of school in."

U.M.C. not only offers classes to strengthen the student's mind, but also offers alternatives to the scholastic grind. Lectures by world newsmakers, concerts, and plays, all offer the student experiences which will aid him in the future so that he is able to communicate and work well with others.

Although there is a very large and active social life for the engineer to enjoy, he must also learn to budget his time. Engineering at U.M.C. is one of the most difficult undergraduate degrees awarded. Although any degree is difficult, engineering requires a strong foundation of mathematics, chemistry, and physical sciences which give the engineering department an attrition rate of nearly 70 percent. Within an engineer's first two years he is expected to take nine hours of physics, five hours of chemistry, sixteen hours of calculus, twelve hours of engineering sciences, and twenty hours of communications skills, humanities, or social sciences.

If engineering is so hard, why is the school filled to capacity? What would cause an individual to have the desire to become an engineer?

pressive, and do serve as an incentive for engineering students, money cannot be considered the only motive for individuals to become engineers. The field of engineering is an extremely exciting field, and for people like myself, the only degree which is interesting enough to spend four years of school in. As some students find the readings of Aristotle fascinating, so must the student of engineering find the laws of physics. As a truly great musician must have a love for music, the engineer must have a love for science and technology. Money cannot buy love, and thus money cannot purchase one's desires. The most important quality of a good engineer is that he must first, before all other things, want to be an engineer; and for that he must love the excitement of knowledge.

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Trevor Byer's software takes a hard look at telephone traffic.

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The solution that Trevor Byer's team came up with was the Centralized System for Analysis and Reporting, or CSAR. Trevor focused on determining how

much information telephone company managers needed, and how that information could best be reported to them. His responsibilities ranged from software design and systems engineering to field testing of reports and training of CSAR users. With a BS and MS in Electrical Engineering from the University of Illinois, Trevor was prepared for the job.

Here's how CSAR works. Once a week all the Bell telephone companies transmit performance data from their computers to a central computer in Piscataway, N. J. Overnight, CSAR analyzes the information, organizes it for use in many ways, including management reports designed by Trevor, and stores it for retrieval the next day.

From their own computer

terminals, CSAR users in the telephone companies request a variety of reports: from summaries of switching system performance for an entire company to detailed performance of individual switching systems. The reports can be displayed graphically to summarize performance trends over weeks, months, or longer.

CSAR is one of more than a hundred computer-based systems used by the Bell System to provide better network performance and better service to customers.

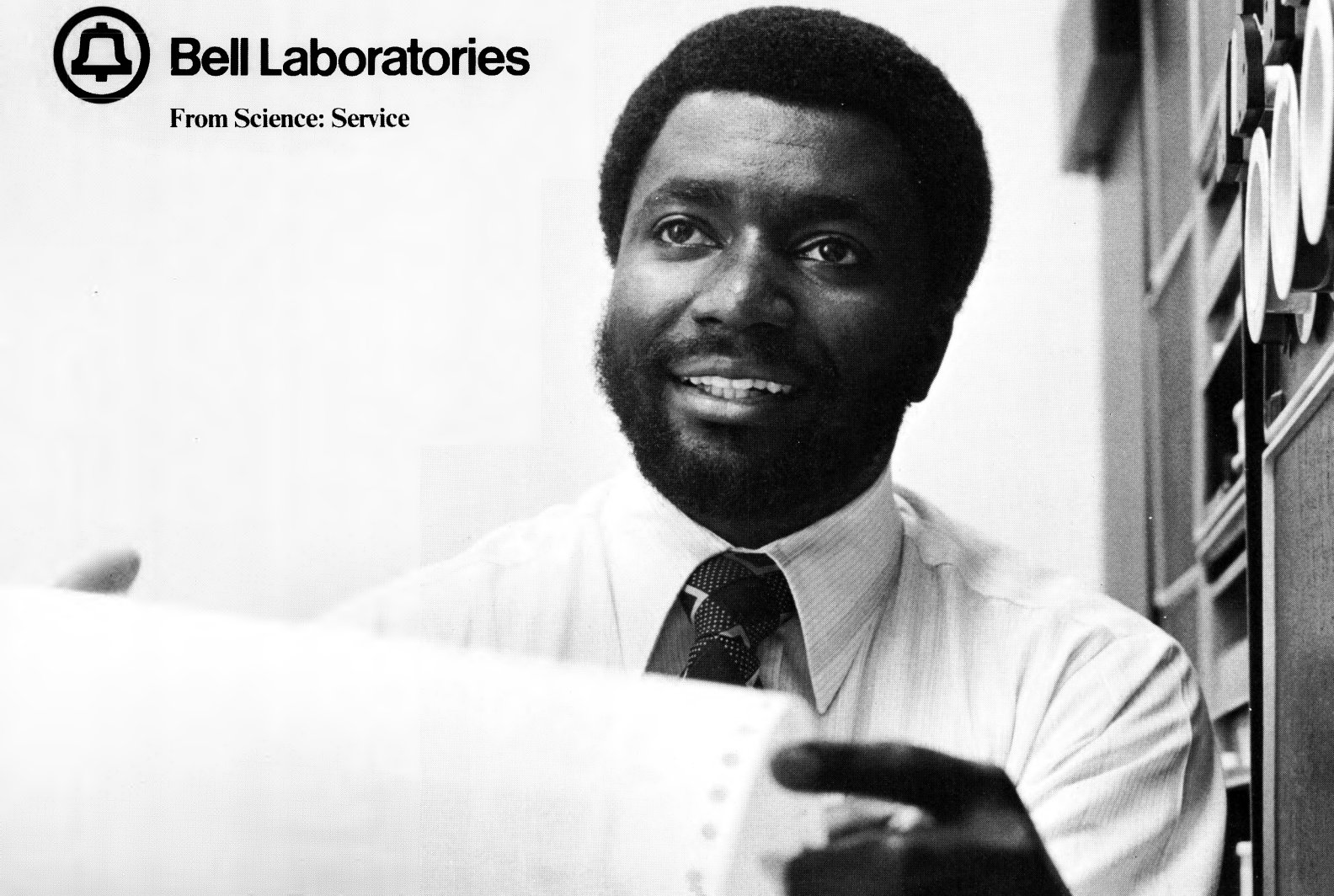
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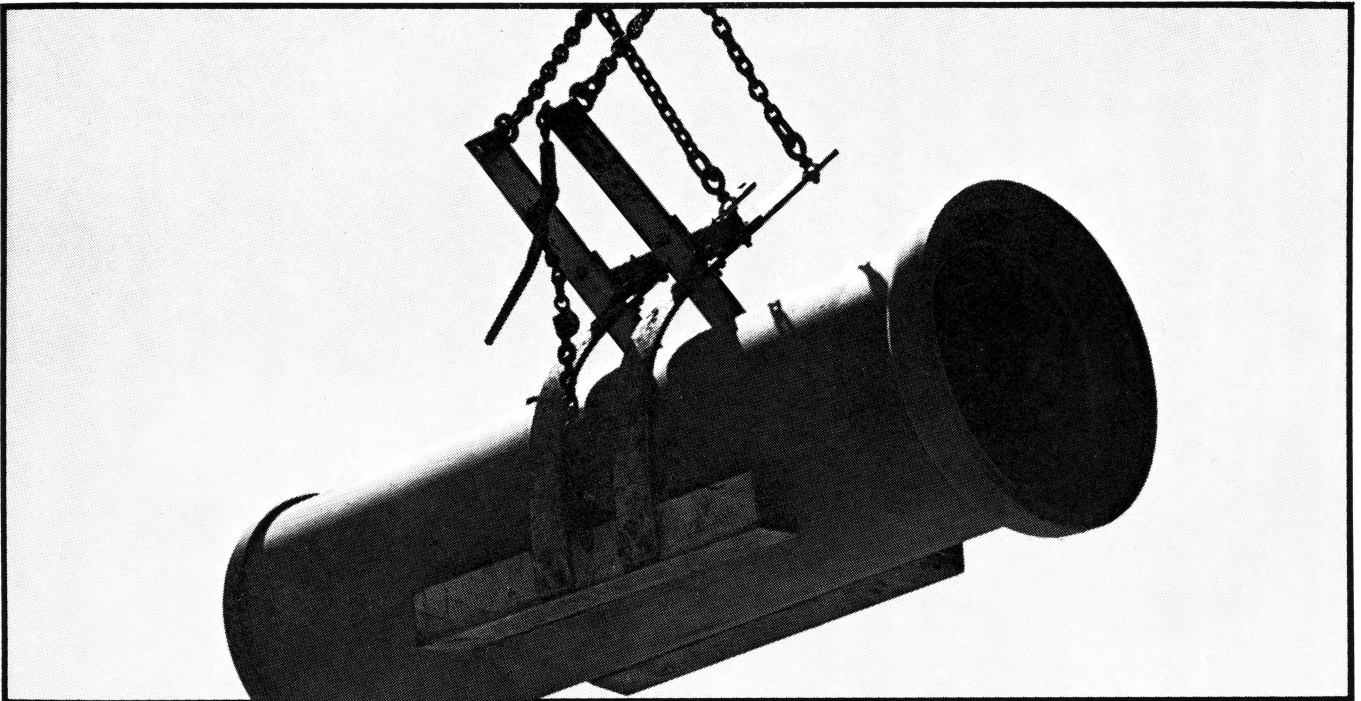
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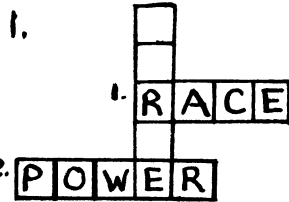
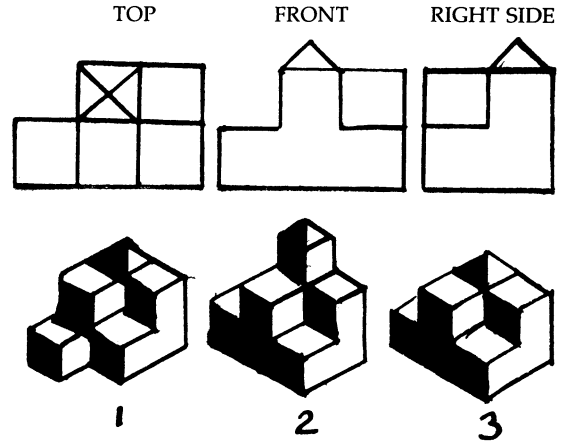


Thought Gallery

by Linda Kral

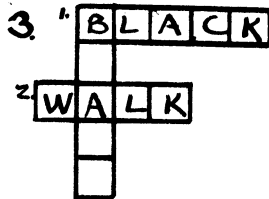
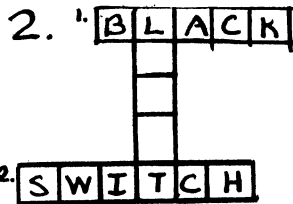
Graphic Fun

Given are the top, front, and right side views of an object and following are three numbered sketches. Try to identify which numbered sketch has the corresponding top, front, and right-side views as shown.



Word Combinations

What word, when combined with each of the two words already entered form two go-together words? Word 1 is the first part of the go-together words and word 2 is the second part.



Solutions

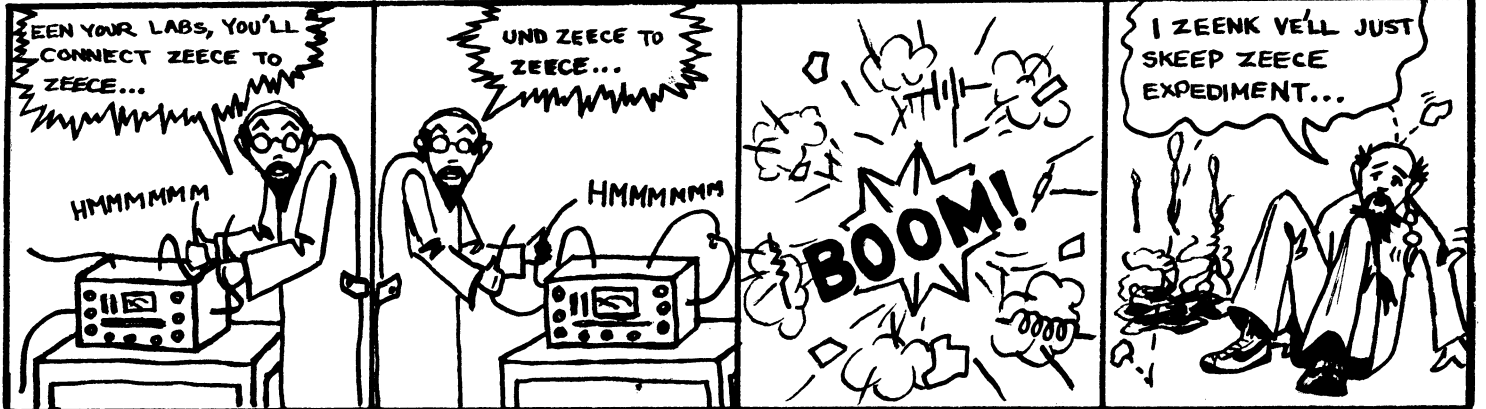
Number 3

Graphic Fun

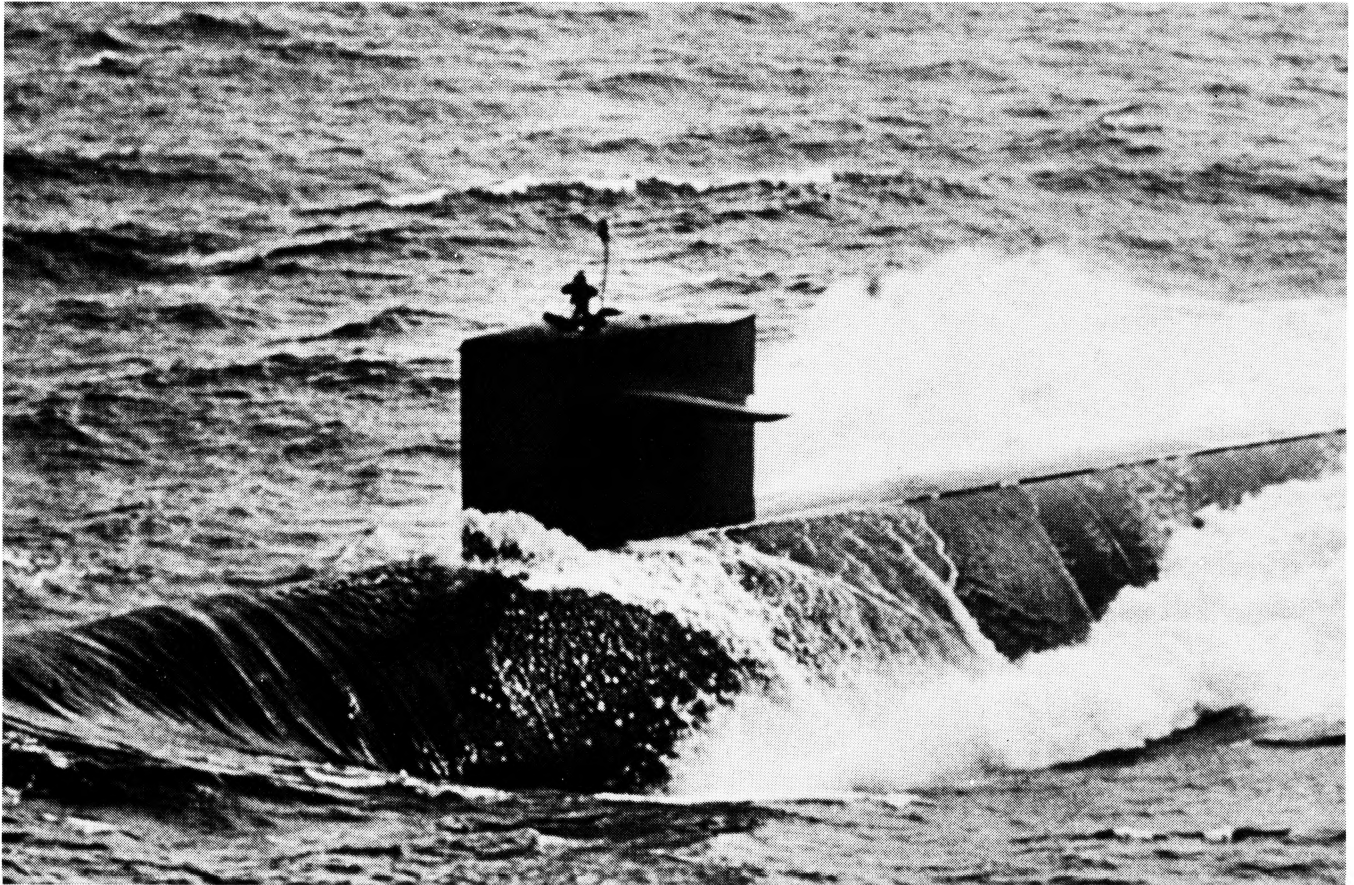
3. BOARD
2. LIGHT
1. HORSE

Word Combinations

ENGR. FOLLIES



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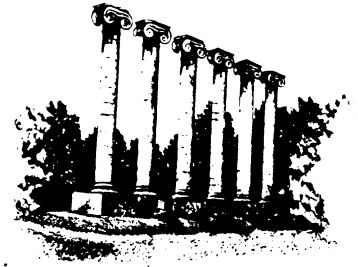
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West of the Columns

by Linda Kral



Last spring University Staff Awards were received by two members of UMC's engineering staff. Both winners were awarded 750 dollars. Larry Clark received the award in the technical/professional category. Larry, an engineering technician for eleven years, designs and builds equipment for professor and student research projects. He has worked with lasers, wind tunnels, shock tubes, gas plasma, and crystallography during his years in the mechanical labs. The tools of his trade include lathes, grinders, shapers, saws and drill presses.

Larry got his start as a technician in a machine shop during World War II. "It was a good place to learn," he said, "because the shop built all its own machinery." He liked what he was doing and because it was easy for him to read blueprints, he stayed there for eight years until the company opened a factory in Des Moines. He went to the factory as a foreman and later was promoted to plant superintendent. He moved on to other positions in the area until he decided he wanted to be a farmer. He bought a farm near Centralia and moved back



Larry Clark

to Missouri. But three bad crop years in a row made him realize that he needed to return to machine work. He sold the farm, came to work for the College of Engineering, and bought 20 acres, where he built a new home.

"The best thing about my job", said Larry, "is it is not repetitious. Most projects are one of a kind and very interesting. Sometimes, I have to scratch my head and find out how to do it but it is always fun and challenging."

Larry loves working with students. He says he often has students who

volunteer to come in and work for free simply to learn machining skills. He gets calls and letters from students all over the United States telling him the experiences they gained under his teaching is often the most valuable knowledge they bring to their job. Larry speaks fondly of one student he considers a son. The student's lease expired as he started writing his dissertation. Larry offered him a place to stay so the student, his wife, and young daughter moved in with Larry. Larry says he often receives calls from the student telling him about his work. Larry says its hard not to get involved with the students because they are so eager to learn and are really interested in the work.

Larry is a favorite of the College of Engineering staff. On a recent morning he arrived at work to find the door to his shop blocked by over 100 empty boxes. The boxes had been autographed by employees from departments all over the College. "I have been involved in numerous practical jokes so I enjoyed having the tables turned. It was a fun way to begin a Monday morning."

Dr. William Carson, professor of mechanical engineering, says he couldn't function without Larry. He says Larry is extremely valuable and his productivity would be very low without him. Dr. Carson, who has worked frequently with Larry, says he has always been extremely nice, hard working, punctual and trustworthy. "Larry always turns out

work for me that is as good or better than I ask. He never practices shoddy workmanship. He takes pride in his work, the pride of a craftsman."

Dianne K. Robinson was the other engineering staff member to receive a University Staff Award. Dianne, senior secretary of mechanical and aerospace engineering, was unanimously endorsed by the members of her department for the secretarial/clerical award.

Ms. Robinson, they said, prides herself on accuracy, promptness, confidentiality and loyalty, and her judgment is invariably sound. Her



Dianne Robinson

high level of performance makes it possible for the department chairman to delegate many responsibilities to her, leaving him time to focus on departmental policy.

A remarkable level of *esprit de corps* exists in the office, the nominators said, so that at a time of high enrollments and a reduced faculty, the office remains a pleasant place where colleagues willingly share assignments. Under her leadership, the office staff has become top notch, reflecting her dedication.

Students wrote that Ms. Robinson shows she really cares about them,

using her time to straighten out their problems and to help them with paperwork.

But most of all, she is a source of encouragement and strength to those around her. "As my supervisor," one employee wrote, "Dianne has given me encouragement and instilled confidence in my own ability. She has a unique ability to teach by inspiring, and is always supportive of my efforts."

Ms. Robinson, who has worked for the University for seven years, is also on the Board of Directors of the Woodhaven Sheltered Workshop for Handicapped Persons.

The *Shamrock* offers its congratulations to Larry Clark and Dianne Robinson for the standard of excellence that they have set.

In other engineering news, the *Shamrock* would like to say a special thank you to Professor James M. Beauchamp, Jr., faculty advisor of the *Missouri Shamrock* since 1971. Professor Beauchamp is a professor of industrial engineering and has



James Beauchamp

been director of Engineering Extension since 1967. He received his B.S. and M.S. degrees in industrial engineering from Lehigh University in 1941 and 1948, respectively. Professor Beauchamp has been with the University of Missouri since September, 1959. He has been an active member of many professional societies and community groups including the National Society of Professional Engineers, the Missouri Society of Professional Engineers, and the Columbia Chamber of Commerce.

The *Shamrock* welcomes Margaret Kraeuchi as its new faculty advi-



Margaret Kraeuchi

sor. Ms. Kraeuchi has been with the College of Engineering three years as director of communications and instructor in extension education. Her duties include news and information about engineering, publications for the College and Engineering Extension, and the development of short courses in communications for practicing engineers.

A freelance editor as well, Margaret holds bachelor's and master's degrees in English. Before coming to engineering, she held various positions in information at the campus and system levels.

photos by Rene Chouteau

And You Will Belong

(Ed. note: Reprinted from *Shamrock* Oct. '79, Tom Ziaja's article still has meaning to us students.)

All students have problems. Perhaps because they are new to college life, freshmen seem to have the most.

No two freshmen have the same problems, but that does not mean there are not those common to most. The belief that no one else can help you is probably wide shared, and, like most problems, can be disposed of simply by talking with other students. Most will help if they can. Remember—no problem is unique.

The one other problem that most affects the freshman is one of peer pressure. Don't buy it. Don't yield to the pressure of others to drink, smoke, or whatever; if you do it, let

it be a freely made decision of yours. Not a friend's, because a friend would not pressure you.

As for grades, if you feel like they are going the wrong way, ask for help from anyone. Chances are, you find someone who has had the class before, and they can help you. Try studying, as it has been known to help. But not too much or you may crack. Go to the free movies to relax and keep your mind off of school, for a while at least.

Finally, if you feel like you don't belong, if you feel like a stranger, the thing to do is be as friendly as you can, and it will come back to you. You have to live with people the rest of your life, so you might as well start learning how. Join a club that interests you. Sports are a good

way to get to know others. Become involved in things to let people know who you are. You will see new paths open up, and new ways to move towards your goals. And you will belong because you will be the source of belonging. And others will seek you out, because you are setting the course.

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UMC Researches Electric Van for the Department of Energy

by Dennis Sisco

Most people have heard or read of the advent of the electric vehicle. However most have not been informed of the various opportunities and advantages for employing the quiet, efficient, nonpolluting electric power. The University of Missouri is one of six universities receiving grants from the Department of Energy to explore the electric vehicle's (E V) ability to replace the internal combustion engine (ICE) vehicle. Areas of interest to the government are: electrical energy consumption, maximum distance traveled on a fully charged battery, effects of terrain, and maintenance requirements.

The van weighs 2,690 lbs., is 64.4 inches high, 135 inches long, and 59.9 inches wide. It has a capacity of two passengers with 76 cubic feet cargo space and 650 lb. cargo tolerance. The transmission has reverse and four forward speeds. The maximum speed is near 50 mph with an acceleration of 0-30 mph in 10 seconds. The van will cruise at the maximum speed for 45 to 50 miles on level roads.

In usage, the Department of Energy is exploring the private sector, state and local government, federal agencies, and universities. Six universities were awarded grants to research uses for E Vs: University of Alabama, Northern Arizona State, Purdue, Texas A&M, University of Maryland, and the University of Missouri. A \$10,000 grant was awarded to the Electrical Engineering department at the University of Missouri with Dr. Richard G. Hoft, professor of electrical engineering, in charge of the project. Dr. Hoft is assisted by Dr. Byron Sherman, Earl Caruthers, and Frank Robey.

The actual assembly of motor, controller, batteries, and wiring was engineered by Jet Industries, Inc. of Austin, Texas.

The research project, engineered by Dr. Hoft, is designed to access the applicability of an electric van in transporting daily campus mail. The van, itself, cost \$9,116.50 of the \$10,000 grant; the rest is expected to be used for parts and maintenance. According to Dr. Hoft, the van has a Japanese body and was originally in-

tended for an internal combustion engine.

The *Electra Van 600* sports a rating of 20 horsepower at 4707 rpm. The powerhouse is a General Electric series wound type motor weighing 160 lbs. This is the same motor Jet Industries uses in cars and small pickups. The most amazing thing about the motor is its silent operation. In fact, the only noises heard are traffic and occasionally the controller humming.

The controller is a fully electronic

"When considering that 97.5% of all driving . . . averages 20 miles or less . . . the electric car casts itself in an excellent position."

device that adjusts the average delivered power by changing the wave peak width while holding the frequency constant. The SCR (Silicon Controlled Rectifier), or thyristor, as Dr. Hoft explains, acts like a little switch that goes off and on very quickly, when on the motor receives a maximum voltage and when off the motor receives zero voltage, in turn to establish an average voltage one controls the speed of the switch.

William Hamilton, author of *Electric Automobiles*, says, "With the batteries now available, designing an electric car is much like what designing a conventional automobile would be if a tankful of gasoline weighed over 60 kilograms per liter, roughly 85 times its actual weight", (the battery in reference here is, of course, the lead acid battery). The conventional car battery ranks somewhere between rubberbands and hydrogen peroxide in energy densi-

ty. To be more exact the lead acid battery has storage capabilities of 35 watt-hours per kilogram, while gasoline approaches 13,007 watt-hours per kilogram. The Exide XPV-23-3 lead acid battery is not an ordinary car battery; though designed for golf carts the battery fills the needs of electric vehicles for the street as well. The individual battery weighs 29.5 kilograms, provides six volts, and can supply 75 amperes for 106 minutes before the output voltage drops below 5.25 volts. Over a period of two hours it will deliver 27 watt-hours per kilogram or .1 MJ/kilogram. To be able to effectively replace an internal combustion engine vehicle the electric vehicle would have to be economically competitive. Consider that the combustion of one kilogram of gasoline releases about 48 MJ of energy as heat. The average efficiency of the internal combustion engine system is seldom more than 20%. Taking the weight of the gas tank to be about one third that of the gasoline itself leaves about 7.2 MJ of mechanical energy available, with these figures the ideal mechanical energy from one kilogram of a battery source is little more than 1% of the mechanical energy available from a kilogram of gasoline in a tank.

A true analysis of cost cannot be obtained until an efficiency scheme is understood. The ideal mechanical energy obtained from the batteries is a simplified approach. Actually the source electricity has to pass through a battery charger which is 90% efficient into the battery assembly at about 75% efficiency, so already 35% of the energy has been lost in

(cont on page 26)

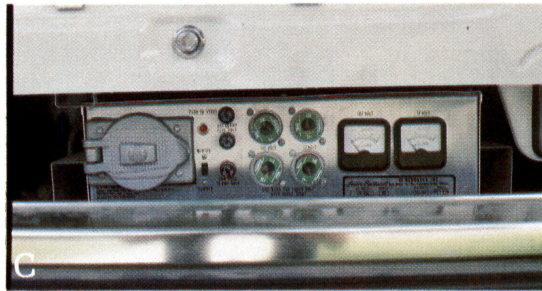
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Photo Essay: Inside the *Electra Van 600*

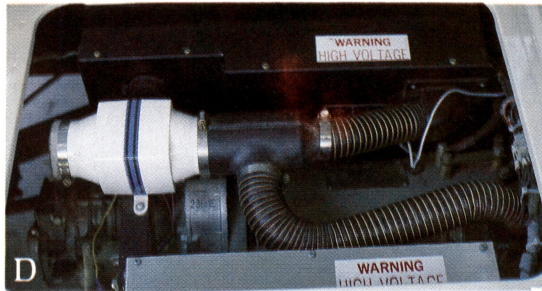


A. The Electra Van 600 in city traffic: the van ranges 50 miles per charge and has a maximum speed of 50 mph. The van accelerates 0 to 30 mph in ten seconds.



B. The battery system is hidden beneath the backseat and contains 17 6-volt batteries, in addition to the 12-volt accessory battery (visible in the upper left corner of the picture).

C. Permanently mounted to the rear of the van, the charger can be plugged into either 110-volt or 120 volt outlets. Because a full charge takes eight hours, overnight charging is recommended. Once charged, the van operates for 12-14 hours driving time.



D. The battery powered cooling system controls the temperature of the battery system and the electric motor. The air cooling process also removes fumes from the motor.

E. Earl Caruthers, engineering technician, stands by the newest UMC mail delivery vehicle. With the University for 13 years, Earl is assisting the Electrical Engineering department test the electric van for the Department of Energy.



photos by Rene Chouteau

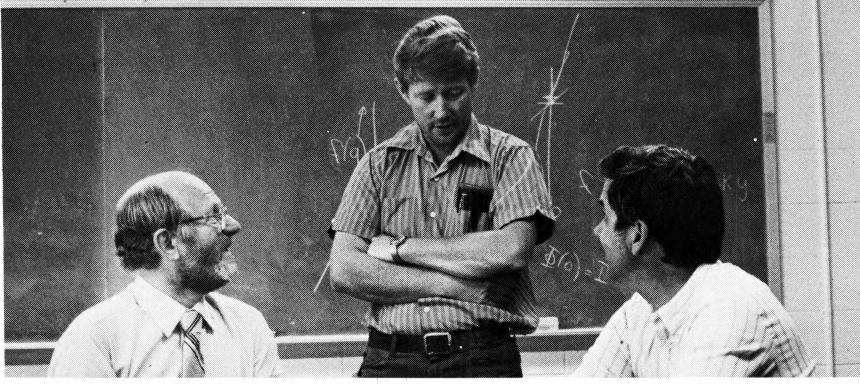


photo by Rene Chouteau

Dr. Richard Hoft, Mr. Earl Caruthers, and Dr. Byron Sherman discuss the electric van. Not pictured is graduate Frank Robey.

the battery system. The motor and controller receive the voltage from the batteries and their combined efficiency is 82.5%. The transmission and rear axle at 94% efficiency round out the electromechanical losses at 16%. In essence the wheels receive about 50% of the original input energy.

The overall cost analysis of the electric van compared to an internal combustion vehicle getting 25 miles to a gallon of gasoline could be made if the efficiency of all the components of the van are assumed to be constant. The energy needed to recharge the 17 batteries from 80% discharge with 75% battery efficiency and 90% charger efficiency would be 16.7 kilowatt-hours. The average nationwide cost of electricity is 4¢ per kilowatt-hour, giving the energy cost at 1.67¢ per mile. An internal combustion engine vehicle getting 25 miles to the gallon at \$1 per gallon would cost 4¢ per mile. The problem now is the cost of replacement of the batteries. According to Mr. Hamilton, "the EV-106 golf car battery is often purchased for a little over \$40. At \$40 apiece the 17 batteries would cost \$680 to replace. The battery life is 500 deep discharges and the total distance traveled on each discharge is 40 miles, yielding a 20,000 mile life span. Therefore a 3.4¢ per mile cost has to be added to the 1.67¢ per mile cost of the electricity for a combined cost of 5.07¢ per mile. If gasoline cost \$1.27 per gallon the cost of an electric vehicle would be lower than

an internal combustion engine vehicle getting 25 miles per gallon."

The problem of the electric vehicle is the batteries. The lead-acid battery of 1985 will probably have storage abilities of 46 watt-hours/kilogram (1.31 times the current value), while by 1990 the Lithium/Aluminum metal sulfide battery will store 115 watt-hours per kilogram (3.29 times the current lead-acid battery). But, as Mr. Hamilton remarks, "This may be the basic source of over-optimism about batteries: it is so much easier to foresee the potential performance than the implicit practical problems". While lithium is considered a trace element, lead is not, this would infer low availability and potential high cost. The battery problem is receiving nationwide attention today with private industry and several universities.

The advent of the electric car is upon us. Some cars such as the Bradley GTElectric have a top speed

of 75 mph, 0-30 mph in 8 seconds, with a driving range for less than a penny per mile. The "Current Fare", a stationwagon, will go 55 mph for about 60 miles on a full charge. The U.S. Postal Service tried using 30 electric vehicles in Cupertino, CA with success, a superb downtime record, and the total maintenance cost per vehicle was \$204.30 per year. The list of companies employing electric vehicles goes on, Bell Systems, Tramways, etc. With this advent comes the relief the country's needs. The problems with the petroleum imports cause ripples in all the industries. These ripples would be mitigated if a major swing towards electric vehicles became practical. The coal supplies in the U.S. are large enough to handle an increase in electric consumption and nuclear power could be employed as needed for future demands. The effect of less pollution due to car exhaust in the major cities would save many lives. Currently, with research in car design and battery improvement, the electric car is much more appealing to the suburban household as a second car. When considering that 97.5% of all driving for trips averages 20 miles or less, the range of the electric car casts it in an excellent position.

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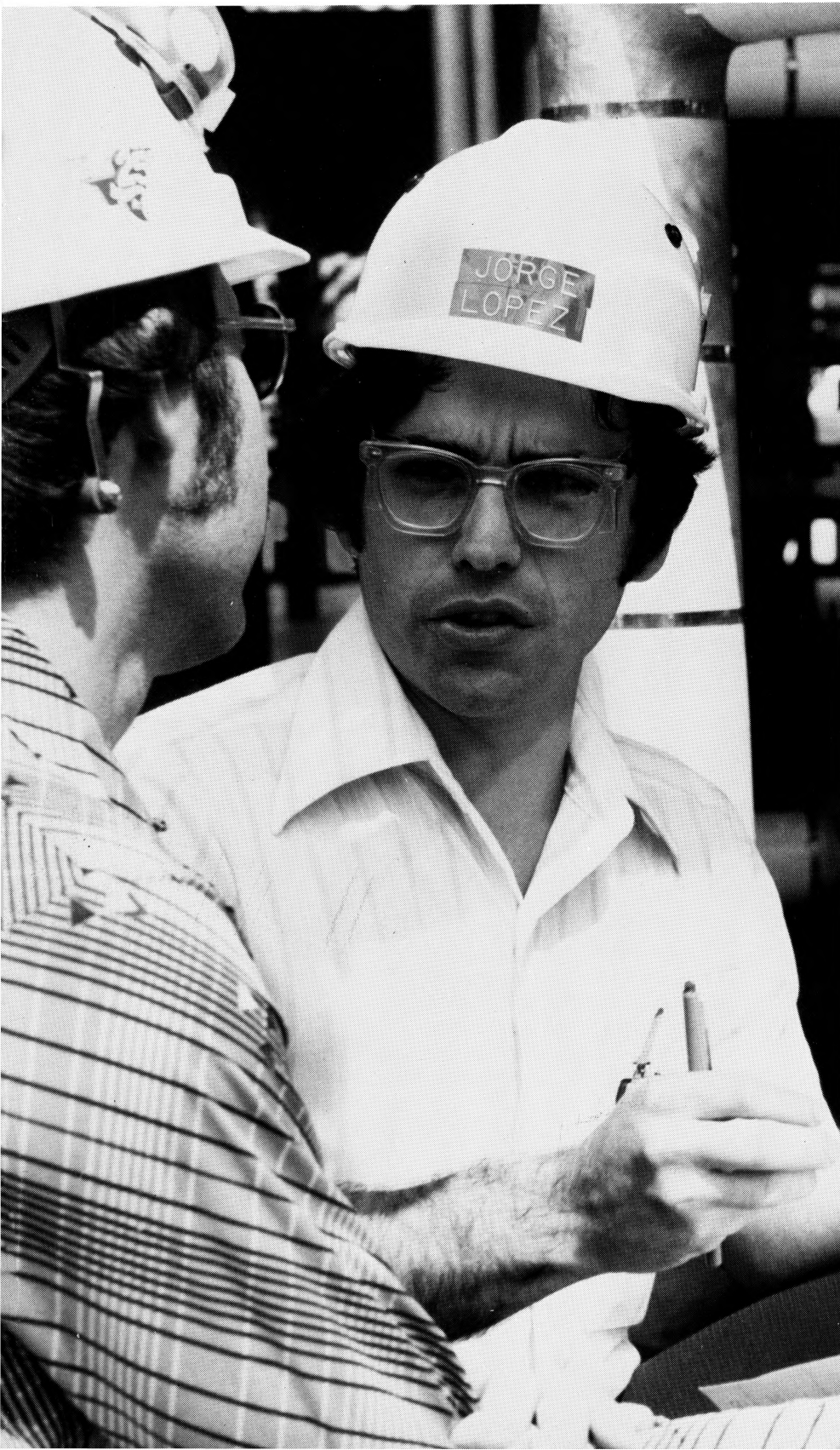
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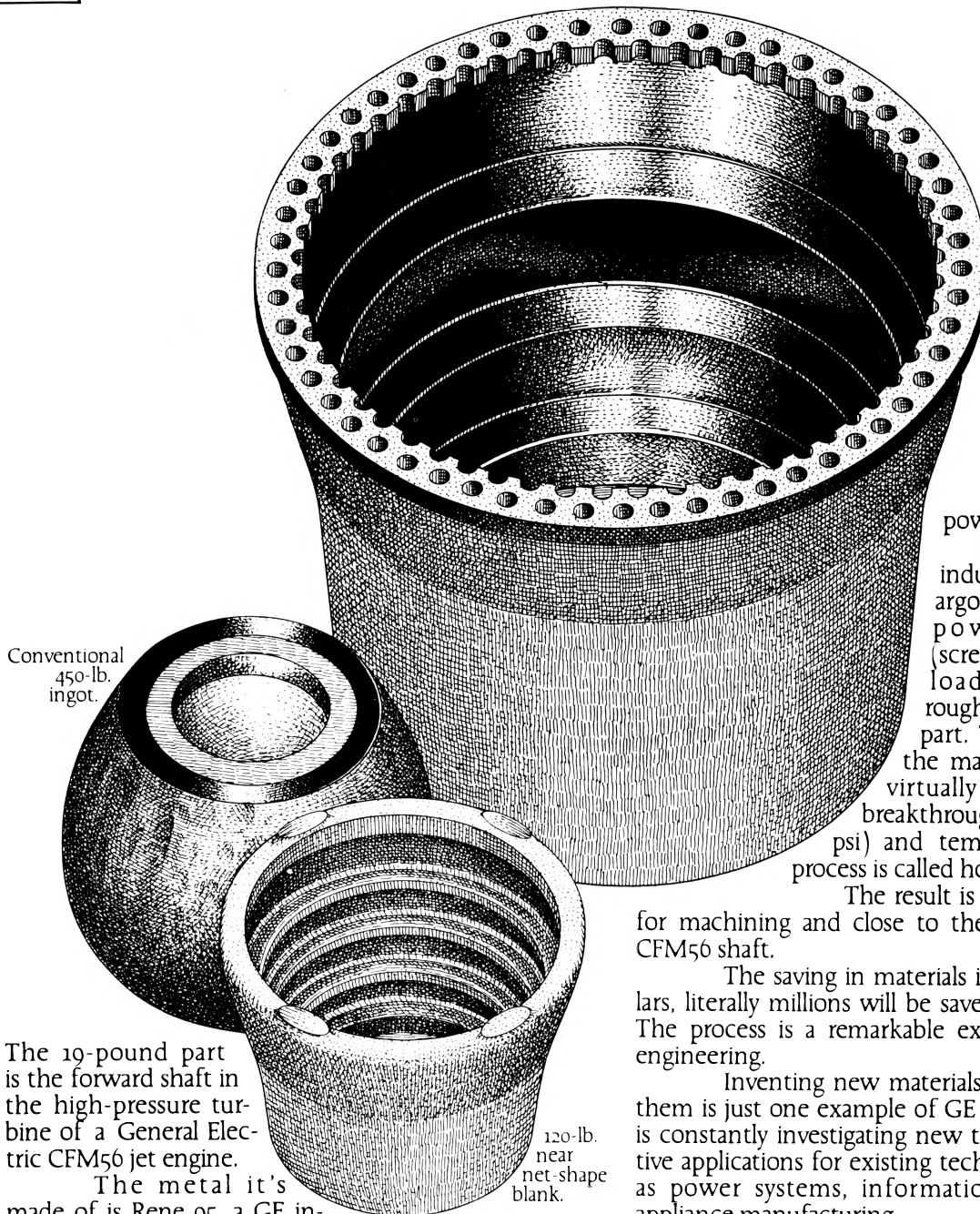


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Missouri Shamrock

The UMC College of Engineering Student Magazine

1980/81

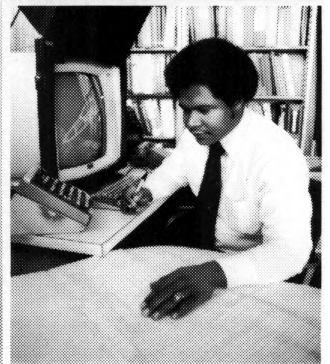
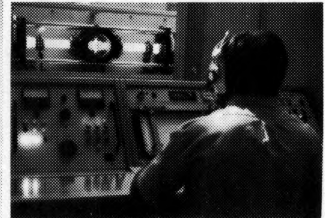
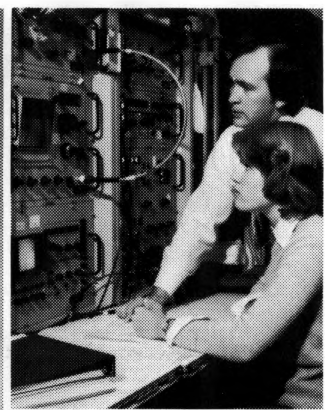
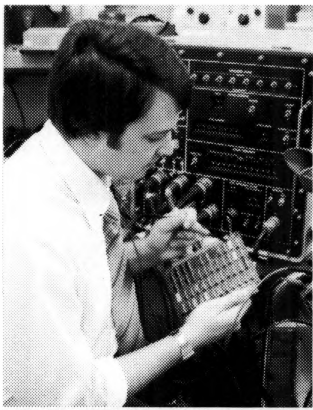


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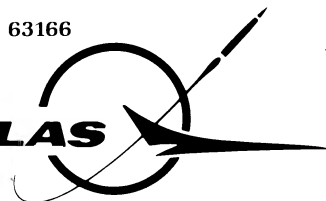
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The UMC College of Engineering Student Magazine

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Larry Clark welds a pipe while working on the engineering renovation. Read Linda Kral's story on page 6. Picture by George Higginson.

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Foremost, the *Missouri Shamrock* gratefully acknowledges its advisor, Ms. Margaret Kraeuchi, Director, Engineering Communications.

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Kathy Ziaja

Dr. Clifford Tompson

CONVERSATION

by David Wilkerson

Physics 124—a course that all engineers at Mizzou must take at some point in their college career. In this issue, CONVERSATION talks with Professor Clifford Tompson about himself, the course, his exams and students.

CONVERSATION: Dr. Tompson, could you first explain a little about yourself?

DR. TOMPSON: I received my degrees here at the University of Missouri. In 1959 I got my Ph.D with my thesis being concerned with X-ray diffraction. Since the completion of the nuclear reactor, I have been involved with neutron diffraction studies.

CONVERSATION: What kinds of differences and similarities do you see between engineering and physics?

DR. TOMPSON: There is a tremendous overlap in some areas. For example, people in electrical engineering (modern electronics), could just as well of been solid state physics students and vice versa. We also work closely with mechanical engineers in the area of materials research.

CONVERSATION: Can you describe your teaching responsibilities?

DR. TOMPSON: I've taught Physics 124 for several years now and they tell me I'm going to have to do it until I get it right. I like working with students at that level. They're responsive, they don't just sit there. They may boo or hiss or laugh, but at least they participate, and teachers like students to participate in the class. I would rather they boo than sleep, then I know that they're at least listening. I think I get along with my classes pretty well and I don't see my name written on the walls any more than other people. You realize that the big white desks in Physics 124 are susceptible to various types of graffiti during the year and we do enjoy walking around reading them.

CONVERSATION: Do you have a unique teaching style?

DR. TOMPSON: I just do what comes natural to me, I don't plan or orchestrate anything. We get good students who can learn, but the problem is to motivate them. I'm sure there are students who really dreaded taking Physics 124 and after taking it they said it was horrible. But I also hope there are some who come out saying that they were glad they took the course

and I believe there are some.

CONVERSATION: What about the type of exams you give?

DR. TOMPSON: I'll always defend the concept of giving a thinking type problem. If the student comes into a test with a little memory bank of stored data points and writes them out in some particular sequence, he hasn't been tested on how good of a student he is. It also doesn't tell how the student can think or contribute to the solution of a problem as an engineer. If a student is ever to make a contribution, it's because of something he can do better than someone else can. When I give an exam, I tell the students the average will be about 50 per cent. Many of them are shocked because they are used to test averages of about 85. But I don't think those are fair to the students. If a student has a bad day when he takes the test, it's easier to recoup his grade if the test averages are lower. Exams with a lower average also help show the good students how good they are.

CONVERSATION: What motivates you as a professor and why are you teaching at a university?

DR. TOMPSON: Well I guess if I didn't like to teach young people I wouldn't be here because there is a lot of job satisfaction in that. I don't think I was made to be just a teacher. My wife teaches second grade and I could never solve and face the kinds of problems she has to. I also have a tremendous amount of respect for high school and junior high teachers. They have a fantastically difficult job that is not appreciated. We don't have the same kinds of problems here and that makes the job a lot more pleasurable and I like it. I don't know why. People that can answer that question with a big flowery answer have usually prepared it.

CONVERSATION: So is the expression you use, 'Physics is fun', really true?

DR. TOMPSON: Yes. But most people don't know the second part to that: 'Physics is fun, Physics is great, it leaves you in the excited state.'

A NEW FACE FOR ENGINEERING

by Linda Kral

The setting is the University of Missouri-Columbia, 1893. The scene is the construction of the engineering building, first in a series of eight divisions to form what is now the engineering complex (see diagram).

Eighty-seven years later the scene is again one of construction. Portions of the engineering complex are currently being renovated. Why and

what is being done? Due to the age of the engineering buildings, some type of renovation is naturally needed to update classrooms and laboratories. Three departments—civil, mechanical, and chemical—consulted with architects and submitted proposals for renovation of their respective departments. Five to six million dollars were needed to carry

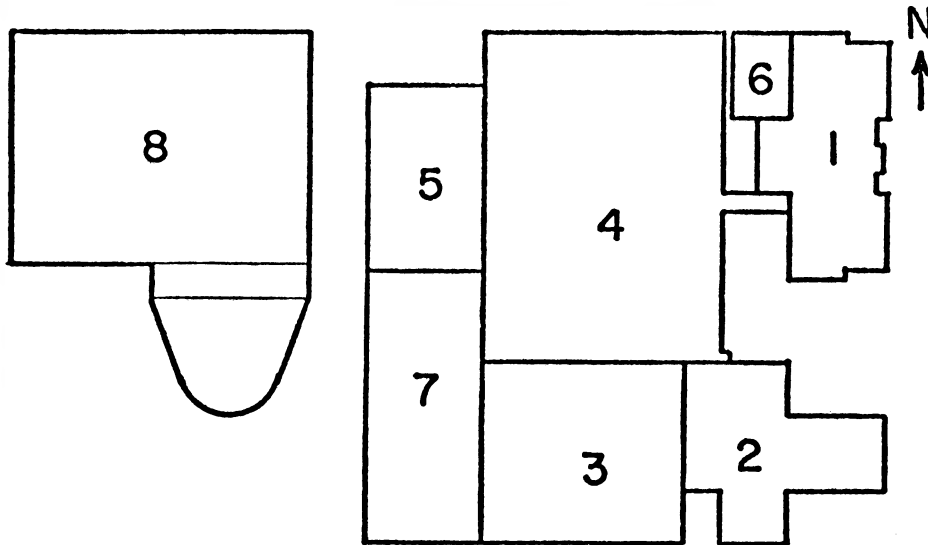
out the submitted proposals. However, only \$1.98 million was allocated to all three departments and so priorities and feasibility of the proposals were defined for each department based on the allocation of funds.

The civil engineering department has been in Phase One of the renovation since last fall. The civil engineering building was built in 1893 and was known at that time as the mechanic arts building. This building is the home of classrooms, faculty offices, and the student lounge. In 1922, the civil engineering laboratories were added to the engineering complex and more laboratories were again added in 1957.

The civil engineering department is applying their portion of the renovation funds to a cosmetic surgery of the mechanic arts building. Dr. John O'Connor, chairman of the civil engineering department, considers their portion of the renovation a "very highly student oriented renovation." Classrooms are being carpeted for improved sound properties and better lighting facilities are being added to improve visual aids. A new climate controlled heating system is also being added to the building for energy conservation and a more comfortable classroom atmosphere. An attractive student lounge will also be provided from a fund contributed to by the civil engineering alumni.

Dr. O'Connor claims the renovation is rapidly moving and should be completed this month. There have been a few setbacks due to labor strikes and materials problems, but occupation of the building should begin next semester. During the course of the renovation, some of the

UNIVERSITY OF MISSOURI—COLUMBIA
DEVELOPMENT OF ENGINEERING BUILDINGS



- 1 Engineering Building, 145' front, 70' deep. Built 1893; cost \$30,000.
- 2 Mechanic Arts Building, 108' front, 117' deep. Built 1893, burned 1911; repaired 1929, 1922, cost \$44,500.
- 3 Engineering Laboratories (Civil Engineering), 185' x 109'. Built 1922, cost \$47,000.
- 4 Engineering Laboratories (Chemical, Mechanical, and Electrical Laboratories), 207' x 140'. Built 1936, cost \$57,000.
- 5 Engineering Laboratories (Mechanical and Electrical Laboratories), 110' x 52'. Built 1949, cost \$338,700.
- 6 Engineering Annex (Offices), 38' x 48'. Built 1951, cost \$40,000.
- 7 Engineering Laboratories (Civil and Chemical Laboratories), 160' x 52'. Built 1957, cost \$504,000.
- 8 Electrical Engineering Building, 123' front by 190' and 300-seat auditorium. Built 1958, cost \$1,500,000.

NOTE: A two-story brick veneer frame building, 145' x 75' called the Engineering Annex occupied the east half of the space shown as Building #4 in the above diagram. This building, occupied by the Electrical and Mechanical Engineering laboratories, design rooms and offices, was torn down in 1936 to permit construction of Building #4.

faculty members have been housed at 614 Maryland Avenue and classes have been taught throughout campus. However, knowing what lies ahead for the department has caused little complaining. In celebration of the event when the civil engineering building will be turned back over to the department, Dr.

O'Connor has developed a calculator contest, at his own expense, for determining the date of completion of the renovation. One contest has already been conducted without consideration given to the delays that have occurred. However, only one student hazarded a guess, October, and thus won a mini-calculator.

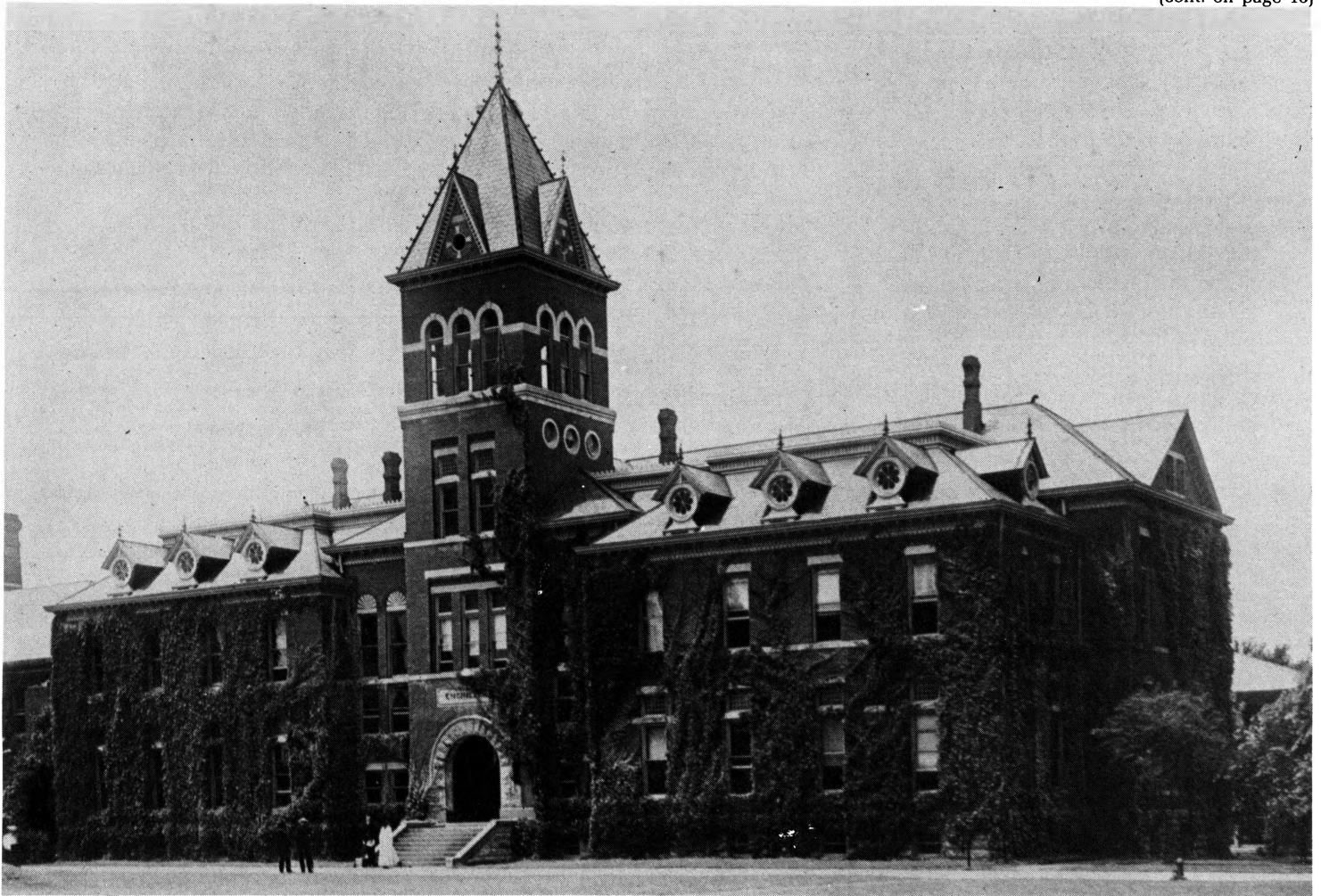
Phase Two of the contest is currently under way with three divisions: faculty and staff, graduate students, and undergraduate students. The completion date is to be decided on the date Professor Jay McGarraugh moves back into his office. When the renovation is completed, Dr. O'Connor plans a celebration and dedication.

Phase Two of the renovation comprises the mechanical and chemical department's laboratories. The mechanical engineering department is housed in the main engineering building built in 1893. The mechanical engineering laboratories were built in 1936 with an addition in 1949. The department is applying their funds for renovation, which began this past summer, to their 1936 laboratories.

Double decks are being constructed in the laboratory bays. The me-

(cont. on page 18)

"Classrooms are being carpeted for improved sound properties and better lighting facilities are being added to improve visual aids."



This 1910 photograph of Engineering shows the ivy and the four chimneys that once graced the building.

Shamrock's Directory

If an engineering student has ever considered joining an organization or club but wondered which one, or for that matter, which one he or she would be eligible to join, this listing of various student engineering organizations on the UMC campus might prove helpful. There were twenty-one student organizations in engineering last year, ranging from student chapters of national societies to honorary fraternities and social clubs. A significant number of upperclassmen engineering students do belong to at least one organization for a variety of reasons; such as: becoming acquainted with fellow classmates, social gatherings, and resume enhancement. For whatever reason someone might decide to join an engineering organization, the benefits are certainly worthwhile. A brief explanation of each organization is described in this article. *Those interested in joining a club can leave a note in the Student Organization mailbox, basement of Engineering.*

American Society of Ag Engineering

ASAE is the student organization of the national chapter on campus. Its purposes are to promote interest among agricultural engineering students and to educate them about their profession. The local dues are \$2 per year, in addition to the national \$10 annual dues. A monthly journal is mailed to the student when the national fee is paid. Membership in the student chapter is restricted to undergraduates in "good" academic standing. Social events include an annual spring banquet, picnics in both the spring and the fall, and trips to various cities for regional and national meetings.

Alpha Epsilon

ALPHA EPSILON is the honorary fraternity for agriculture engineers. Its main function is to recognize students' abilities and achievements. A \$12 lifetime fee is paid by those who are initiated. A student must be in the upper-quarter of his class (either the second semester junior or senior year).

American Institute of Chemical Engineers

AICE is the student organization of the national chapter on campus. Its purpose orients graduating students to the chemical engineering profession. Members are charged \$2 per year for renewals as are new students. Undergraduate students in "good" academic standing are eligible to join. A roller-kegger for the faculty and students during the school year and seminars in various cities highlight the activities.

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of Engineering Societies

by Tom Sapienza

American Society of Metals

ASM is the student chapter of the national Society. It is designed to stimulate interest in the field of metals and engineering materials. Activities include co-sponsoring a materials-engineering seminar space series, plant trips, and discussions of topics in engineering. Dues are \$6.00 a year, which includes a monthly magazine and news letter.

American Society of Civil Engineers

This organization is the student chapter of the national society. Its purpose familiarizes civil engineers with those in the profession and the practicing field. A \$4 fee is charged to all members. All students in civil engineering are eligible to join as long as they are successfully completing courses to a certain degree. A field trip is scheduled yearly and involvement with community activities are on the priority list, such as the installation for a half way house and the design of a playground for children.

To become acquainted with other electrical engineers on a professional level, is the main purpose of the organization. A \$10 fee is charged to the student each year he remains in the local chapter until graduation. Membership is available to all electrical engineers with at least a "2.0" grade-point average. The national organization mails each member a monthly publication of a magazine, the *Spectrum*.

Eta Kappa Nu

Eta Kappa Nu is the honorary fraternity for electrical engineers. Its objective is to get honor students together and to recognize their achievements. The student, at the time of initiation, is assessed \$36 for a lifetime membership. Only the top-quarter of juniors and seniors are eligible to join.

Chi Epsilon

Chi Epsilon is the honorary fraternity for civil engineers. Its function is to acquaint the students with the faculty on an informal basis and to promote the recognition of student achievements. A lifetime membership costs \$30 to \$40. Only the top third of upperclassmen are considered. Usually a grade-point average of "3.0" for juniors and 2.5 for seniors is the bare minimum to be considered.

American Institute of Industrial Engineers

The AIIE is the student chapter of the national organization. Its purpose is to share common experiences between colleagues and the profession of industrial engineers. A \$10 membership fee is required each year per student, and a monthly magazine is mailed to the student. No grade-point average is required except that it must be over a "2.0". There are bi-annual picnics held in

Institute of Electrical and Electronic Engineers

The IEEE is the student chapter of the national society of electrical en-




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(cont. on page 22)

Enrollment Cycles

Eight years ago, the University of Missouri-Columbia engineering program was in trouble. Sharp enrollment declines in engineering enrollment both at Columbia and Rolla created questions as to whether two engineering schools could be supported in the university system. Should the engineering school in Columbia be dismantled and engineering studies consolidated at Rolla, or could both campuses maintain programs, each with a different emphasis? The dilemma was bounced around in committees, and the final decision was to keep both schools. Rolla was to provide a traditional engineering format, while Columbia would offer innovative programs such as bioengineering.

Eight years after the UMC engineering college nearly died for lack of students, the program chokes on the surge of students fueled by vigorous demand for engineers. No longer is there a clear distinction between Rolla and Columbia of traditional versus innovative programs; each school merely struggles to adequately educate the students that swell their programs. No longer does the college plead with people to enter its classes, rather administrators must generate ways of processing a greater volume of people without seriously reducing the quality of education.

The problems facing the college today are obvious. Classrooms and laboratory facilities are overburdened, especially in lower division courses. Student credit hours have doubled over the past ten years, but the number of professors has remained constant. The school seeks to attract qualified professors

to teach here with starting salaries that are only slightly higher than the average received by graduating students with bachelor's degrees. Many* professors estimate that they could nearly double their present salaries with a job in private industry. And money is not the only crippler of professor recruitment. Availability of candidates is so limited in the industrial engineering

university offers "a unique job style and suites a lot of people's interest," remarks Dr. Goldman.

While the school has had little success attracting new talent, professors already here must assume greater work loads. Most professors teach two classes and work on one research project. Increasing class sizes mean more work for teachers and less individual attention for

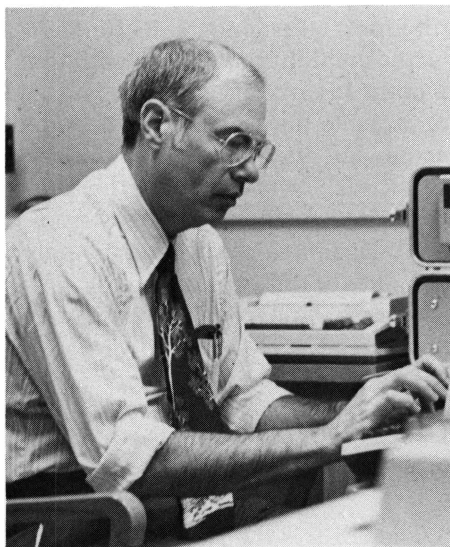
Student credit hours have doubled over the past ten years, but the number of professors has remained constant

field that the department at UMC can expect to look several months to fill a staff opening. According to Dr. Jay Goldman, the search for a needed IE professor is already in its second year. In spite of the fringe benefits and higher pay scales industry offers, though, the

students, and future enrollment boosts could force many professors to teach three classes unless additional staff could be found.

The engineering college has not been blind to the problems it faces. Restrictive state funding and difficulty in finding new personnel have limited the number of students the program can educate without deterioration in educational quality. This has forced administrators to look at potential ways of reducing incoming students.

One of these limiting processes may already be underway. Electrical engineering grade averages have fallen sharply over the past several years. The Fall 1979 grade average for lower-level EE courses was 2.385, while lower-level course averages in the Fall of 1972 were 52 percent higher at 3.633. Similar trends are also seen in upper-division courses. When enrollment was low, grades were inflated to attract people to the program, and now



Dr. Jay Goldman

Trouble Engineering

by David Scott

that enrollment is high, grades are plunging, and this constricts the flow of people continuing into upper-division courses.

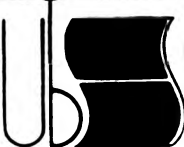
Another alternative under consideration by the college is currently used by the journalism and business schools to control admission to their programs. A minimum grade point average would be required before a student could move into the upper-division courses. This

method gives the administration tighter control over the enrollment, for the cutoff grade point average could be adjusted depending on space available in the program, and this would financially benefit the school because upper-division classes, which are more expensive to offer than lower-level courses, would be reduced in size.

Several American universities in similar situations as UMC have re-

duced enrollment by limiting admission of foreign students. Middle Eastern students comprise 12 percent of the students in electrical engineering. This politically volatile alternative is being approached with caution by administrators, especially because such a policy would have implications for the entire university system.


As enrollment outstrips educational capacities, the engineering administration will be forced to make difficult decisions. Limiting enrollment is anathema to an administration that still feels the sting of nearly losing the program for lack of students, but action will have to be taken to prevent basic engineering courses, which establish the foundation for all further engineering studies, from becoming enormous, impersonal lecture classes. If enrollment continues its upward climb, new resources or new restrictions will be needed to prevent erosion of educational quality.



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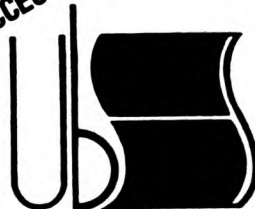
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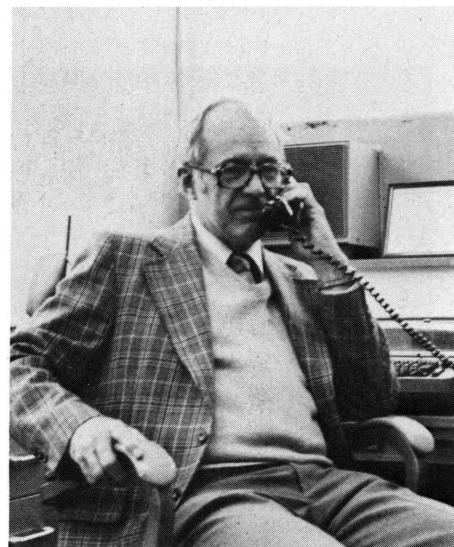
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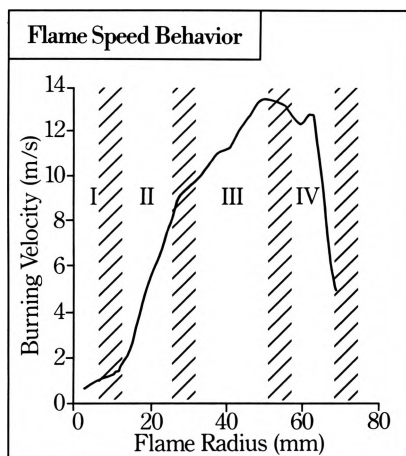


Dr. Robert Carter

Kathy Ziaja

The Turbulence Parameter

Energy-efficient operation of the internal combustion engine requires the highly turbulent movement of fuel and air in the chamber. Recent advances at the General Motors Research Laboratories provide a new basis for determining what degree of turbulence will get the most work from each drop of fuel.



Burning velocity plotted as a function of flame radius. Combustion stages are indicated by roman numerals.

High-speed photographs showing flame evolution (lasting six milliseconds) through four stages: initiation (I); flame growth (II); full development (III); termination (IV).

WITHOUT TURBULENCE, the highly agitated motion of cylinder gases, combustion would take place too slowly for the gasoline engine to function. Predicting combustion behavior in order to design engines with greater fuel efficiency depends upon understanding the relationship between vital, turbulent gas motions and burning rate. The challenge is to quantify this relationship—a complex task made more difficult by the requirements of measuring a transient event occurring in a few milliseconds within a small, confined space.

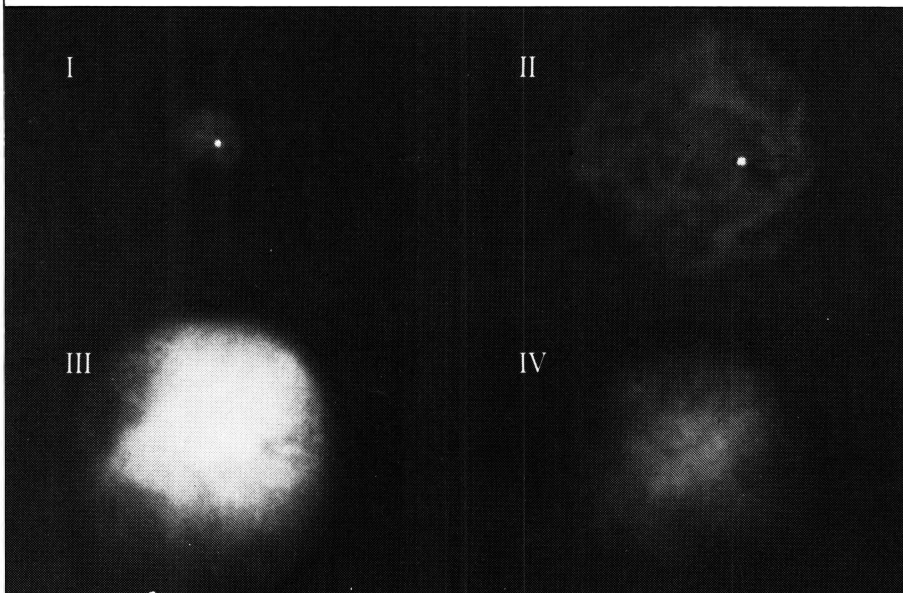
New knowledge of how turbulence affects flame speed has been revealed in fundamental studies conducted at the General Motors Research Laboratories by

Drs. Frederic Matekunas and Edward Groff. Their investigative results have been incorporated into a model that successfully predicts the effect of engine design and operating conditions on power and fuel economy.

The researchers separated their experiments into two phases. In the first phase, they measured turbulence in the engine cylinder; in the second phase, they determined flame speeds over a broad range of operating conditions. Testing took place in a specially designed, single-cylinder engine equipped with a transparent piston to permit high-speed filming of the combustion event.

Hot-wire anemometry was applied to measure the turbulent flows while the engine was operated without combustion. Instantaneous velocities were calculated from the anemometer signals and simultaneous measurements of gas temperature and pressure. More than 400,000 pieces of data were processed for each ten-second measurement period.

The significant measure of turbulence is its "intensity," defined as the fluctuating component of velocity. Because conditions in the cylinder are both transient within cycles and variant between cycles, separating the fluctuating and mean components of velocity is inherently difficult. The researchers overcame this problem by using a probe with two orthogonal wires properly aligned with the direction of the mean flow.



In the combustion phase, tests were performed at over one hundred operating conditions of varied spark timing, spark plug location, engine speed and intake valve geometry. Detailed thermodynamic analyses were applied to the recorded cylinder pressures to calculate flame speeds throughout combustion. High-speed films were analyzed frame by frame to validate flame speeds and to characterize how gas motions influence the initial flame.

The researchers used these measured flame speeds, turbulence intensities, and the conditions under which they occurred to formulate a burning law for engine flames. They divided the combustion event into four stages. The initiation stage begins with ignition and ends as the flame grows to consume one percent of the fuel mass. In the second stage, the flame accelerates and thickens in response to the turbulent field. The third stage exhibits peak flame speed. In the final stage, the thick flame interacts increasingly with the chamber walls and decelerates.

OVER THE RANGE of turbulent intensities encountered in engines, the researchers were able to describe the turbulent burning velocity, S_T , during the critical third stage of combustion with the expression:

$$S_T = 2.0 S_L + 1.2 u' P_R^{0.82} \beta$$

S_L , the laminar flame speed—a known function of pressure, temperature and mixture composition—is the flame speed that would exist without turbulence. The variable u' is the turbulence intensity. P_R represents a pressure ratio accounting for combustion-induced compression of the unburned mixture. The dimensionless factor β accounts for the effect of spark timing on geometric distortion of the flame which occurs during the first combustion stage and persists into the later stages.

The researchers also observed that the burning velocity in the second stage increases in proportion to flame radius, and that in predicting the energy release rate from the burning velocity equation, it is necessary to account for the finite flame-front thickness.

"The form of our burning equation," says Dr. Matekunas, "shows a satisfying resemblance to expressions for non-engine flames. This helps link complex engine combustion phenomena to the existing body of knowledge on turbulent flames."

"We see this extension," adds Dr. Groff, "as a significant step toward optimizing fuel economy in automotive engines."

THE MEN BEHIND THE WORK

Drs. Matekunas and Groff are senior engineers in the Engine Research Department at the General Motors Research Laboratories.



Both researchers hold undergraduate and graduate degrees in the field of mechanical engineering.

Dr. Matekunas (right) received his M.S. and Ph. D. from Purdue University, where he completed graduate work in advanced optics applications.

Dr. Groff (left) received an M.S. from California Institute of Technology and a Ph. D. from The Pennsylvania State University. His doctoral thesis explored the combustion of liquid metals.

General Motors welcomed Dr. Matekunas to its staff in 1973, and Dr. Groff in 1977.



General Motors

People building transportation to serve people

Engineering and Medicine Combine in Diagnostic Technique

by Jennifer Hann

Students enrolled in the nuclear engineering department at UMC have a broad range of fields from which to choose. The traditional area of power production is growing. Also an area known as medical physics which uses engineering and physics concepts is expanding.

A medical physicist must draw upon a knowledge of technical and physical fundamentals to assist in the physicians search for diagnostic and therapeutic information.

Medical physics, which has grown steadily with increasing advancements in the diagnosis and treatment of disease, has its roots in the discovery of X-rays and the establishment of radiation physics. Later progress included continuing X-ray development as well as the advent of radium usage in the treatment of various diseases.

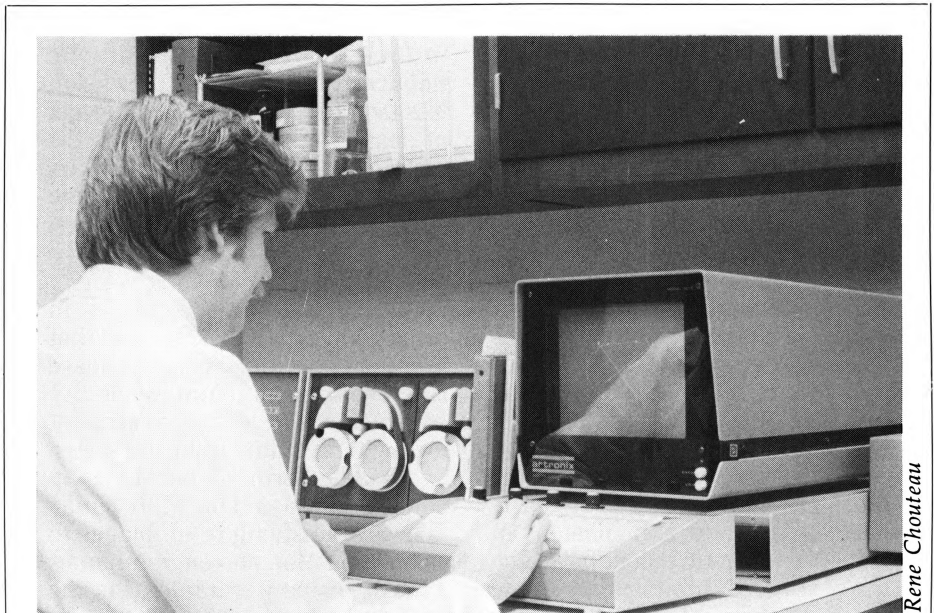
Driven by the outstanding scientific and technological achievements attained during World War II, the young field of medical physics grew rapidly. The emergence of medical physics as a separate entity from basic research physics, was furthered by the development of particle accelerators and the use of nuclear reactors in activating useful isotopes. This separation from basic research physics led to the establishment of the American Association of Physicists in Medicine in the late 1950's.

The medical physics program at UMC is a masters level program that has been modeled along guidelines recommended by the AAPM. According to Dr. Marc Edwards, asst. prof. of radiology, the purpose of this course of study is to prepare a person to function well in a clinical setting. Research is usually designed to accomplish goals that will prove help-

ful to a person professionally. Good candidates for medical physics generally have a background of rigorous physics, as well as higher mathematics.

The impact of increasing technical sophistication has defined more precisely the two major divisions of medical physics: radiation therapy and diagnostic imaging.

Nuclear medicine is a branch of diagnostic imaging in which internally administered radioisotopes are used to evaluate organ function rather than anatomical characteristics. The computer age has greatly aided this pursuit and enhanced image acquisition, making it possible to deliver quantitative information to the physician.



This computer is designed to calculate distributions of radiation absorbed dosages.

Rene Chouteau

In a very broad sense, diagnostic imaging is concerned with acquisition of image information for diagnoses of disease. In order to accomplish this end, the diagnostic physicist must guarantee safe machine operation. Such aspects as machine calibration and quality control, as well as radiation exposure measurements and calculations, are important physicist functions:

The need for a greater understanding of physics became apparent initially in radiation therapy, with the increasingly sophisticated technology at the radiologist's disposal for cancer treatment. Therefore, the radiation physicist is a crucial member of the radiation oncological clinical team, responsible for correct patient set-up, treatment planning and dose calculations and mainte-

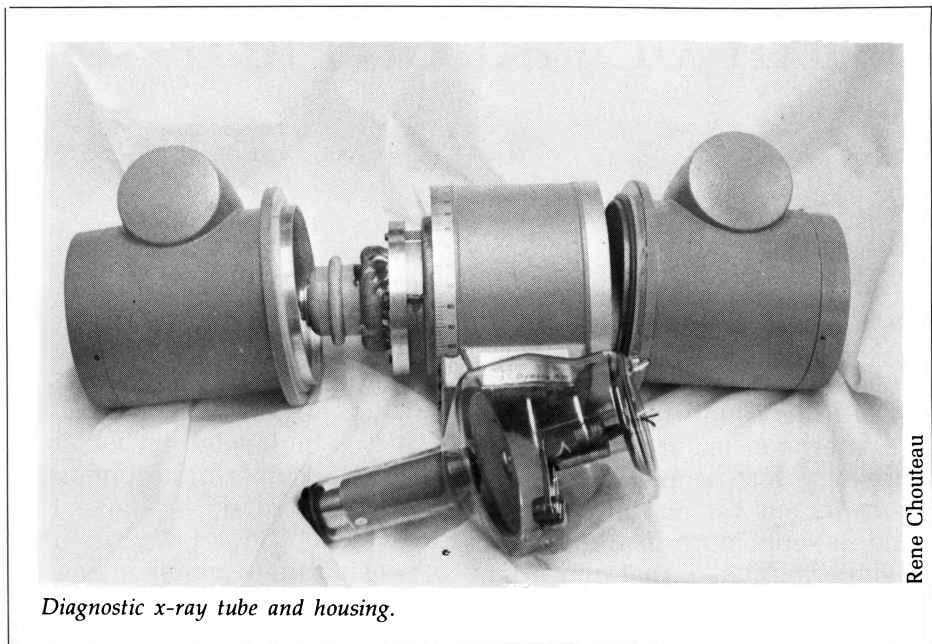
nance of proper treatment quality, as well as routine machine calibration.

Diagnostic physics, as a whole, deals more with equipment, specifications, and quality regulations whereas radiation therapy remains more involved with aspects of patient care, treatment and monitoring. Obviously, as Dr. Edwards points out, the radiation physicist must deal with more responsibility for patient care, including avoidance of possibly debilitating complications from treatment.

Not only is the medical physicist involved, in the strictest sense, with patient care in treatment planning and technical mastery, but also the physicist may be called upon to advise in the development of new facilities, or in machine acquisition and calibration.

The medical physicist must serve as a bridge between the federal regulations controlling and monitoring radiation exposure and treatment and their successful application. This is especially apparent in a community hospital setting, according to Dr. Edwards, where the medical physicist may be the only one familiar with radiation exposure measurements, machine calibration and the technical knowledge to advise personnel concerning radiation.

The diagnostic and therapeutic medical systems industry also may utilize medical physicists in design and production of new imaging and treatment modalities. New imaging techniques include ultrasound, nuclear magnetic resonance imaging, and computed axial tomography. Further, radiographic imaging has been enhanced by improvements in image intensification systems. Medical linear acceleration technology has also advanced greatly. With their understanding of the underlying physical



Diagnostic x-ray tube and housing.

Rene Chouteau

concepts and applications, medical physicists prove valuable in instrument development and sales.

In addition, as medical physics grows, new areas are expanding, with the result that more and more physicists are finding themselves thrust into administrative and regulatory positions, while some are moving into other non-radiological fields concerned with equipment-oriented matters, or facility designs.

At all levels, the view of the medical physicist as a high level contributor to medical care is progressing rapidly and gaining wider acceptance.

As Dr. Edwards concludes, "Given the growing demand, combined with the fewer training programs resulting from a cutback of educational support in general, the job futures for medical physicists appear excellent."

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North of Faurot Field

by Kathy Ziaja

"Down, set, hut one, hut two, hike!"

Does this sound like an average afternoon lecture in engineering? Most people would probably answer no, but Ken Judd, a sophomore in industrial engineering, hears that and a lot more for 4 hours every afternoon. Ken is a linebacker for the Missouri Tigers, and every day after classes it's "go to practice, then study," as he said.

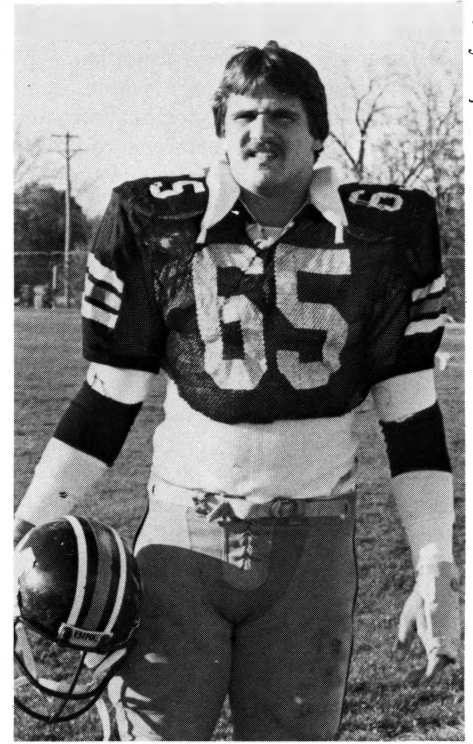
Getting home at about 8 o'clock every night and having a 12 hour schedule this semester, Ken is learning how to use his time more efficiently. He said, "It was really tough in the beginning, engineering and football," but that now the idea is "a little more enjoyable. It seems a little easier learning how to study, how to use my time."

However, this is the first year Ken has traveled with the team. Playing defense, he goes to away games with the special teams, which consist of the kickers, punters, and other members. This means that for most of his weekends, he doesn't have much time to study. The team leaves Friday, plays Saturday, and then returns Sunday to practice for 4 hours in the afternoon.

Because of the limited time these athletes have to study, students and teachers may stereotype football players. Ken commented, "Since I was a football player, they (teachers) thought I was looking for extra help." But football players are treated just as any other student is in asking for help; they get no special

treatment. "At least I haven't gotten any," Ken said.

When he started at UMC, Ken was undecided on which field of engineering to pursue. Having picked IE, he hopes to finish school in 4 1/2 years and is considering a minor in business. Ken likes industrial engineering because it "seems like you can advance better in IE." He also enjoys it more than the other fields because it's "more people related, not just machines."



Ken Judd

Kathy Ziaja

West of the Columns

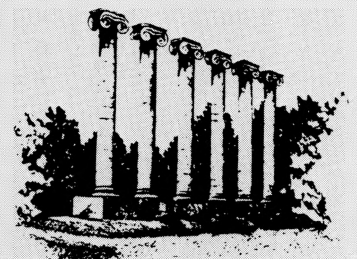
Staff members Rich Geekie and Larry Kremer graduate this December. *Shamrock* thanks both and sincerely wishes them the best in their careers. Larry, photographer, graduates with a degree in electrical engineering and Rich, writer, leaves with a BS in civil engineering.

Also graduating is writer Rose Mary Ryan. Rose Mary graduates with a Masters in EE and wrote *In Spientia Ambulate Tempus Rediments* in last month's issue of the *Shamrock*. Her byline was inadvertently omitted and we hope she forgives our oversight.

Three Engineering professors have been selected to endowed named professorship chairs in the College of Engineering. John O'Connor, chairman and professor of civil engineering has been appointed C.W. LaPierre Professor of Engineering; Richard Hoft, professor of electrical engineering, has

been designated Emerson-Chance Professor of Electrical Engineering; and Sudarshan Loyalka, professor of nuclear engineering, has been named James C. Dowell Professor of Engineering. These professorships are for three years, and renewable, and carry a \$3,000 stipend per year.

Walter Trueblood, manager of administrative services for Black & Veatch, is the new Engineering Alumni Association president. Mr. Trueblood is a former Mizzou football player and a 1957 graduate of UMC.



Thought Gallery

by Jean Babcock

(Ed. note: Shamrock thanks IE graduating senior Jean Babcock for her challenging puzzles.)

Number Series—What is Next?

A. 7, 14, 21, 28, 4, 11, 18, 25, 3, 10, 17, 24, . . .

B. 1, 5, 7, 12, 15, 13, . . .

- a. 17, 29, 27
- b. 16, 14, 25
- c. 14, 23, 28
- d. 21, 35, 27

C. 3, 1, 4, 1, 5, 9, . . .

What is the hidden meaning to this:

May I have a large container of coffee?

Who Stole the Diamonds?

The other day, I was sitting in the EE lounge catching a coke between classes and happened to overhear some engineering students who were trying to convince an agriculture student to transfer into engineering.

Although I did not hear all of the conversation, I did manage to pick up the following facts:

1. Bert, the senior, lives off campus.

2. Carl and the civil engineer were in the same strengths class.

3. Alan and the mechanical engineer were roommates last year.

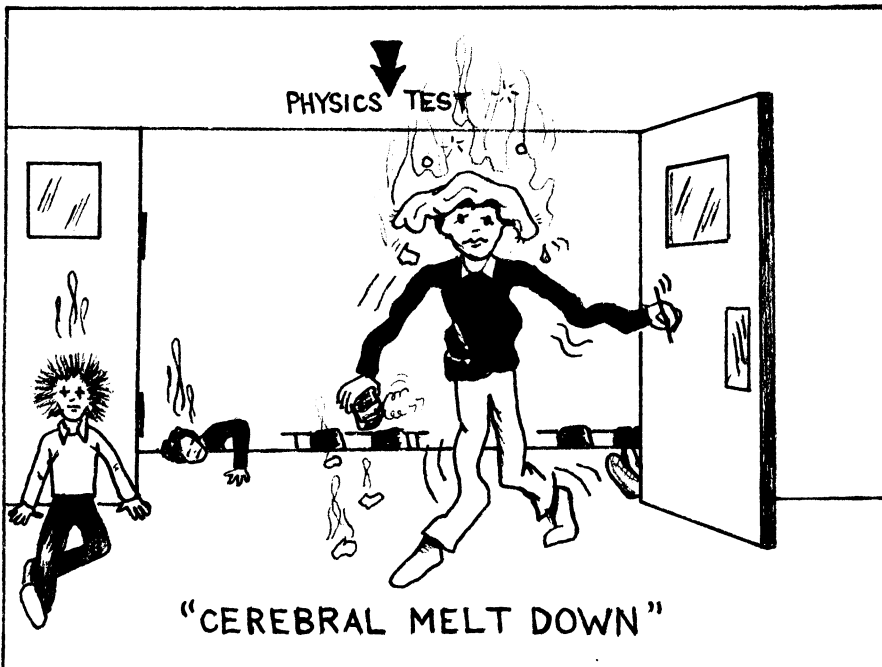
4. The sophomore, Darwood, and the industrial engineer are in the same English 60 class.

5. The mechanical engineer and the junior live in Hudson Hall.

6. The agriculture student and the sophomore live in different dorms.

Who is the agriculture student and what year is he?

(Answers on Page 22)



by Elsa Johnson

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- DESIGN
- PLANNING

CONSULTING ENGINEERS

(cont. from page 7)

chanical engineering department's south bay will be completed while the north bay will just have a slab installed, due to a current lack of funds. On the first floor of the south bay, improved lighting and video capabilities are planned along with a computer aided design room and an instrumentation check-out room. The second floor will house specialization laboratories including a laser facility. To improve safety standards, corridors will pass through the front and back of all bays, with a "superramp" constructed on the outside of the building for handicap access. Undergraduate and graduate students both will benefit from this laboratory renovation.

Dr. Paul Braisted, chairman of the mechanical engineering department, stated that he was very proud of the staff, faculty, and students attitude during the renovation period. Only two classrooms are currently being used in the mechanical engineering department. Dr. Braisted claims that "one way or another courses with required labs are being taken care of." Renovation of the laboratories is scheduled for completion next summer.

The chemical engineering department completes the three departments involved in the renovation process. Chemical engineering is also renovating their laboratories in conjunction with the mechanical engineering department. The chemical engineering laboratories were built along with the mechanical engineering laboratories in 1936 and additional laboratories were added in 1957.

The chemical engineering bay will be decked over for additional space. On the first floor three new research laboratories will be partitioned off while three existing laboratories will be renovated with the shop. One research laboratory, however, will be lost in order to house an air-conditioning system. The second floor will contain some open space over the shop to house tall equipment with the remainder decked over. On the second floor, three research laboratories will be added while two exist-

ing laboratories and two faculty offices will be renovated. Safety features are being added to all laboratories to comply with current safety standards. The nuclear engineering department will also gain one lab during this portion of the renovation.

Dr. George Preckshot, chairman of the chemical engineering department, feels space will still be a problem when the renovation is completed. The department has been plagued with problems due to the construction. According to Dr. Preckshot, the renovation "lacks in-depth planning" by the University since no space was allocated to move facilities during the renovation. Faculty offices are cramped in the engineering annex and current laboratory space is lacking. However, Dr. Preckshot is happy to see the renovation currently under way and is looking forward to the new facilities.

All the renovation has been taking place in the presence of record enrollments. In 1979, the College of Engineering's enrollment was 1961 students, while this year's enrollment

climbed to 2243 students. The college will receive an accreditation visit next fall and hopefully the renovation will be completed by then. No plans currently exist for more renovation phases of the engineering complex although much more is needed to bring the engineering facilities at UMC into adequate condition for the 1980's.

Other proposals, outside of renovation, have been submitted to restore beauty to the engineering complex. One such proposal is to restore the engineering building for its historical significance in technical and scientific education. The engineering building is an integral part of the Francis Quadrangle, a National Historic Landmark. Professor Gayl Bunch of mechanical engineering and Dean William Kimel, have submitted proposals twice to the Department of Natural Resources to restore a portion of the engineering building to the original architectural style of the 1890's. The proposal includes restoration of the entrance and foyer facing the Francis Quadrangle, the front hallway of the main floor, the ground floor and the second floor of



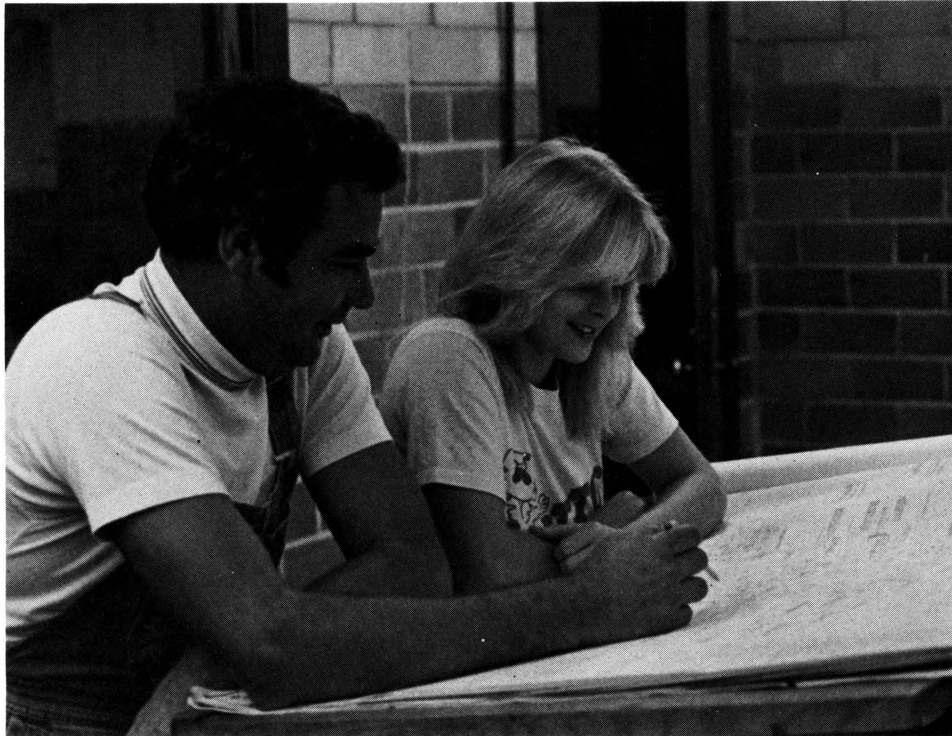
Rene Chouteau



Rene Chouteau

the interior. Ceilings and flooring tile would need to be replaced, restoring the archways as they originally were. On the exterior of the building, four chimneys are down and need restoring while the tower and cupolas need some of the decorative fillagree replaced.

This proposal for restoration of the engineering building was submitted twice, the last time being March 1, 1979. Both times the proposal was rejected unfortunately. Reasons for the rejection may be that a building in the private sector has preference over a public building and the engineering building is still in stable condition. Another reason may be because the cost was too high (\$250,000). No plans currently exist for



Rene Chouteau

submitting the proposal a third time, but perhaps one day the restoration will take place and the engineering building can become a showplace.

To help restore beauty to the engineering building, a mural project has recently been approved by the Executive Council of the College of Engineering. Professor Tracy Montimony, of the UMC art department, designed the mural to be executed on the north wall of the main east /west hall of the engineering building. A scale representation of the mural was placed on display for several weeks in the Dean's office. The mural presents a challenge to Professor Montimony due to the location and fact that the surface consists of brown tones of ceramic brick separated by a grid of mortar. An elevator door is also located on the proposed wall. Professor Montimony's solution is an abstract design incorporating engineering motifs and a bold acknowledgement of the grid pattern due to the bricks. She has titled the mural "Engineering: Images and Symbols".

Dr. Aaron Krawitz, professor of mechanical engineering, is chairman of the Ad Hoc Committee for the Proposed Mural Project. Dr. Krawitz feels that the mural "symbolizes the role of the College of Engineering as a member of a campus with a strong humanistic tradition. It will also be a decorative and stimulating addition to our facility that is consistent with the ongoing program to beautify the campus." The UMC art department will be funding the mural project while the College of Engineering will prepare the wall for painting. The mural is a class project for Experimental Media and will be executed during the winter semester of 1981.

The mural project and the proposed restoration illustrate the interest in having an attractive engineering facility. An attractive complex will draw better students and faculty to UMC's College of Engineering. These projects and proposals along with the renovation shows that the UMC is in tune to the needs and interests of the 1980's.

MAZDA RX-7 STORMS AMERICAN CAR MARKET

“Sleek, functional, and fast—an
affordable 2-seater.”
—MOTOR TREND

by Doug Gardner

—An affordable Japanese sports car which can compete in the American market with Porsche 924 and Datsun 280-ZX? It's true! The long awaited Mazda RX-7 is now a reality. This sleek, rotary powered automobile is storming the States like no other of its kind. The Japanese started with a clean drawing board and attempted to develop an automobile with plenty of interior room, high visibility, and sleek, modern, aircraft-type body styling. And they did it!

fies the finest in sports car interior design. The two bucket seats are full reclining to allow the passengers varying degrees of comfortable adjustments. The center console connects to the bottom of the dashboard and extends downward between the two bucket seats. The console contains the temperature control panel, AM /FM radio, manual transmission stick shift, ash tray, parking brake lever, and other control devices—all within easy reach of the driver and

“. . . Plenty of interior room, high visibility,
and sleek, modern, aircraft-type body styling.”

The RX-7 has a long, smooth, slanting front end to accommodate its well designed aerodynamic feature. The rear end looks similar to something out of the space age with an unframed glass hatch, large combination taillights, and a full width bumper. The inside of the RX-7 typi-

passenger. The instrument panel is centrally located in front of the driver to allow maximum view through the spokes of the leather covered steering wheel. A large flat area behind the seats will carry ample amounts of luggage for driver and passenger.

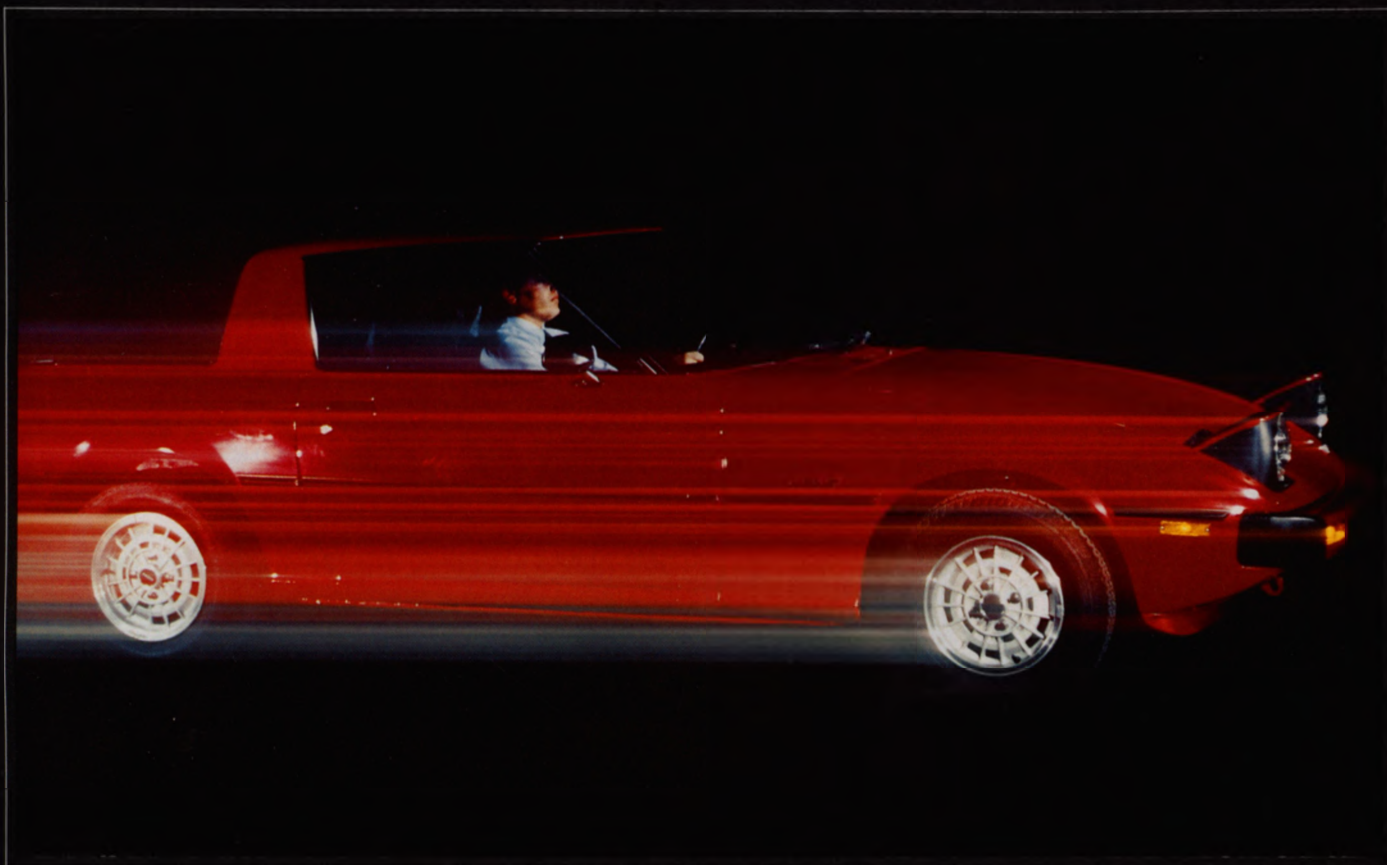
The Mazda RX-7 is powered by a somewhat controversial rotary engine. The rotary engine, developed by Frank Wankel ten years ago, has had its shortcomings. Previous troubles included leaking seals, poor lubrication, and low gas mileage; all of which have been improved upon by the Japanese in the past decade. The rotary in the RX-7 is compact (1.1 litre), light weight (333 pounds), virtually vibrationless, quiet, and has a smooth flow of power from idle to high rpm. The swift rotary thrusts the RX-7 from 0 to 60 miles per hour in a blazing 8.7 seconds, develops 100 horsepower at 6000 rpm, powers the Mazda to a top speed of 125 miles per hour, and delivers an honest 22 mpg. The rotary engine is located behind the front axle to allow a low center of gravity. The wide track suspension system made of

MacPherson struts and coil springs in front, and coil springs with four trailing arms in back allows excellent road handling at all speeds and power front disc brakes and rear drum brakes provide reliable, sure stops.

Two models of the Mazda RX-7 are offered. The base car is called the "S", the better equipped version is called the "GS". Standard equipment for both includes AM /FM stereo radio with power antenna, H-rated radial tires, tachometer, reclining bucket seats, full carpeting, front anti-roll bar, and quartz clock. The "S" model comes with a four speed manual transmission; the "GS" version has a five-speed. Air conditioning is optional for both versions, as is automatic transmission. Mazda warrants that the basic engine block and its internal parts will

be free of defects with normal use and prescribed maintenance for 3 years or 50,000 miles, whichever comes first, or Mazda will fix it free. Mazda also warrants that their air conditioning system in the RX-7 will be free of defects for 12 months and unlimited mileage.

This beautiful automobile has found its way into the hearts of many sports car buffs and the waiting time to receive a special order varies from 4 to 6 months. Despite the waiting list, the Japanese build only 3000 RX-7's per month in order to fulfill a promise to the United States of keeping exports down to 1977 levels. Although the base price of the RX-7 has increased by 22% in the past two years, it is still appealing at \$7195 for the "S" type and \$7995 for the "GS" type. But beware, for another 22% increase will shoot the price near \$10,000.



Rene Chouteau

(cont. from page 9)

the spring and fall. There are also trips to various cities where seminars are conducted.

Alpha Pi Mu is the honorary fraternity for industrial engineers. It recognizes students' achievements in industrial engineering. Prospective members are selected according to their rank in class: the top-fifth in the junior class and the top-quarter in the senior class. A \$25 lifetime fee is due on initiation. *Alpha Pi Mu* promotes industrial engineering within the department and works with AIIE on student advising.

The ASME is the student chapter of the national organization. It promotes mechanical engineering and familiarizes students with each other. An \$8 annual fee is charged to the student, whereupon, the national organization mails the student a magazine monthly.

Pi Tau Sigma is the honorary fraternity for mechanical engineers. It recognizes students in mechanical engineering who excel in their course work. A lifetime membership costs \$35. Those juniors in the top-quarter of their class and seniors in the top-third of their class are eligible to join. An annual banquet is held while social picnics are being considered each semester.

The ANS is the student chapter to the national organization. It familiarizes nuclear engineering students with those in practicing fields. Various speakers visit from the industry to discuss pertinent nuclear engineering material. A \$10 national membership fee is required for those actives in the chapter. The monthly magazine *Nuclear News* is mailed to the student after he has joined or renewed their membership. There is a minimum grade-point average of 2.0. The student chapter sponsors a six-week seminar which introduces students to common problems and advancements in nuclear engineering.

Tau Beta Pi is the honorary fraternity that includes all the disciplines of engineering. It stresses the importance of academics and integrity. Only the top eighth of juniors and the top fifth of seniors are eligi-

ble to join. A \$40 lifetime membership is to be paid upon initiation.

SWE is the student chapter of the national organization. It recognizes the role of women in all engineering disciplines. A membership fee of \$7.50 per year is charged to students. Five issues of the national publication are mailed to members yearly. There is a minimum of 2.0 grade-point average. Speakers visit to discuss their experiences on-the-job and how it relates to the members. Membership is not, however, restricted to women.

SBE is presently awaiting an authorized confirmation from the national organization to become a student chapter. Its main objective is to stimulate interest among black engineering students. It focuses on students to voice problems and stirs them to keep involved on campus. A membership fee of \$10 per year is charged to all active members and soon-to-be members. A newsletter is then mailed to all members. A 2.0 grade-point average is the only requirement. A spring picnic is held yearly. Membership is not restricted to black engineers only.

The SAE on campus consists of mechanical engineers who stress the automotive field. Its purpose is to get students in the automotive field together. Speakers from industry visit the campus and discuss various topics concerning the automobile. Members pay \$4 per year and receive the publication *Automotive Engineering* monthly.

The EGSA was formed on campus to facilitate interests among graduate engineering students and to share common goals and experiences. There is no membership fee and the only requirement is that the member must be a graduate student in an engineering division with a grade-point average of 3.0 or above. One activity among members is to provide committees for the Dean's Office, such as revues for scholarship applicants.

The ESC is the representative voice of all engineering students. Its major duty is to handle the budget which is allocated to the engineering student council by MSA. Students

can join by petitioning during the election months. The officers are elected by students in their own department. There is no membership fee to be on the student council, or a minimum grade point.

The Engineers Club's main objective is to bring all engineering students together and to socialize with each other. The planning for Engineering Week highlight student involvement. A membership fee is \$4 per year is charged to all students. There is not minimum grade point requirement.

You are reading the *Missouri Shamrock*, which is the student College of Engineering magazine. The staff is composed mainly of engineering students and informs on pertinent news in engineering. Those interested in joining the staff may contact any of the staff members listed on the Table of Contents page.

Solutions

A. . . . 31, 7, 14, 21, 28 Mondays of 1980

B. either a or d—number of letters in each # form a numeric sequence

C. 2, 6—don't you recognize pi?

D. Mnemonic for pi—count the # of letters for each word

Who Stole the Diamonds?

A) From 1 Bert is the senior. B) From 2 Carl is not the CE. C) From 3 Alan is not the ME and neither is he a freshman. D) From 5 the ME is not a junior. The ME is not Bert, the senior who lives off campus; C showed he is not a freshman so the ME is a sophomore. F) From 6 the ag student is not a sophomore and is not Bert the senior who lives off campus. G) The sophomore ME (see E) and the junior live in Hudson but the ag student lives in a different dorm than the sophomore, so the ag is not a junior. Therefore, he is a freshman (and the IE and CE are not freshmen). That means that Bert is not the ag student. H) Alan was here last year and cannot be the freshman ag student. I) Alan or Carl is the sophomore but Alan is not the ME (see C), so Carl is the sophomore ME. Alan must be the junior (since is neither the freshman (C) nor senior (A)).

Therefore, Darwood is the freshman ag student.

Darwood—freshman—Ag

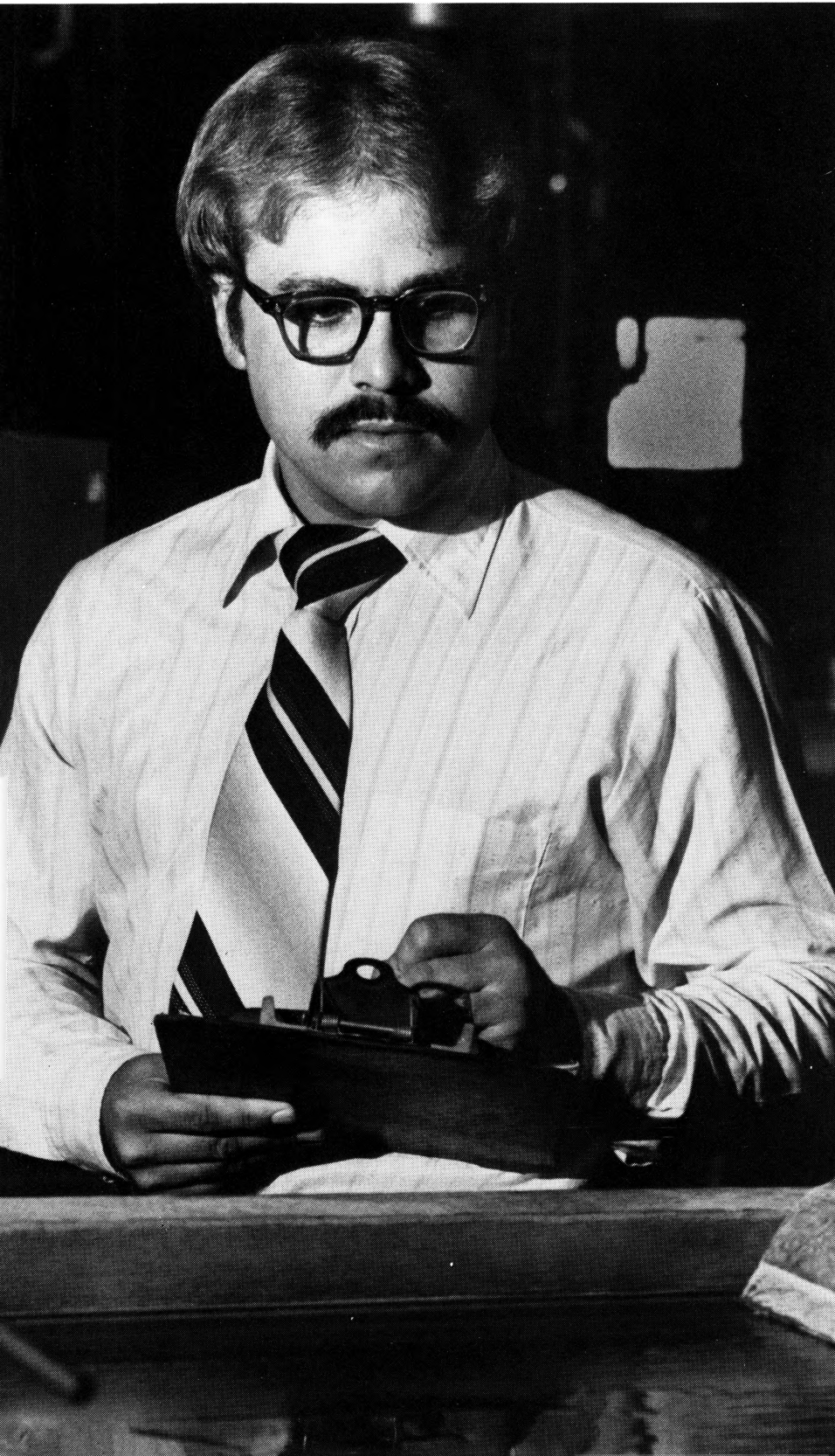
Carl—sophomore—ME

Alan—junior—either IE or CE

Bert—senior—either IE or CE

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Mark Carlson BS, Chemical Engineering



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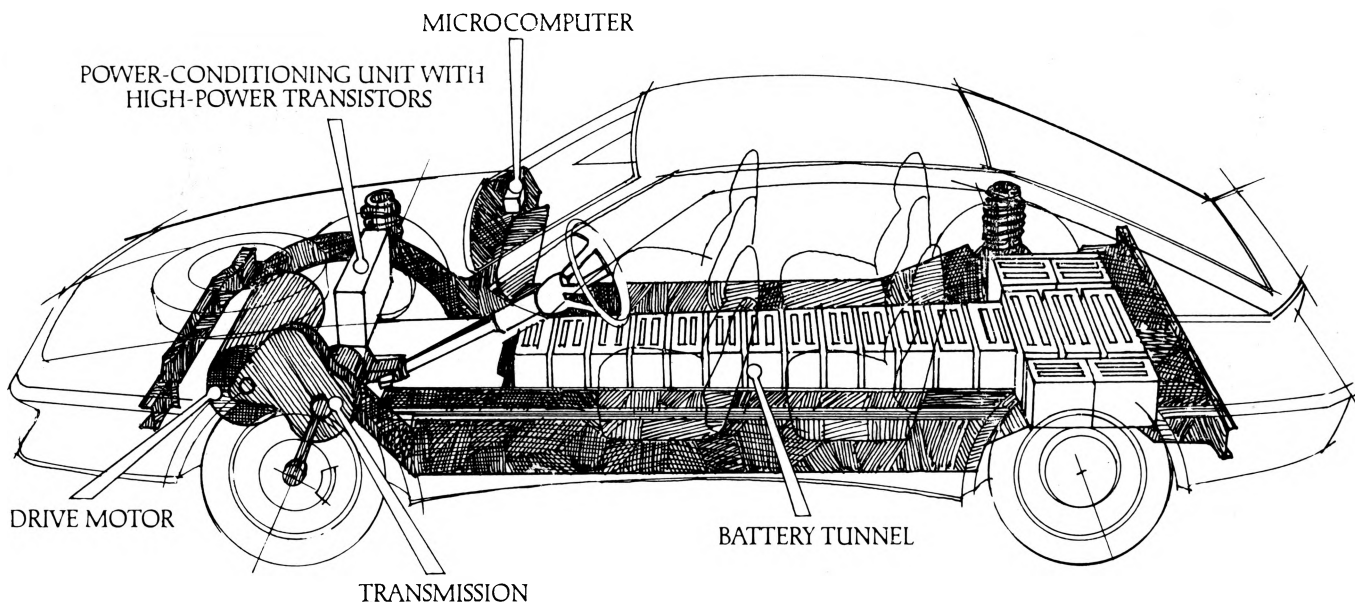
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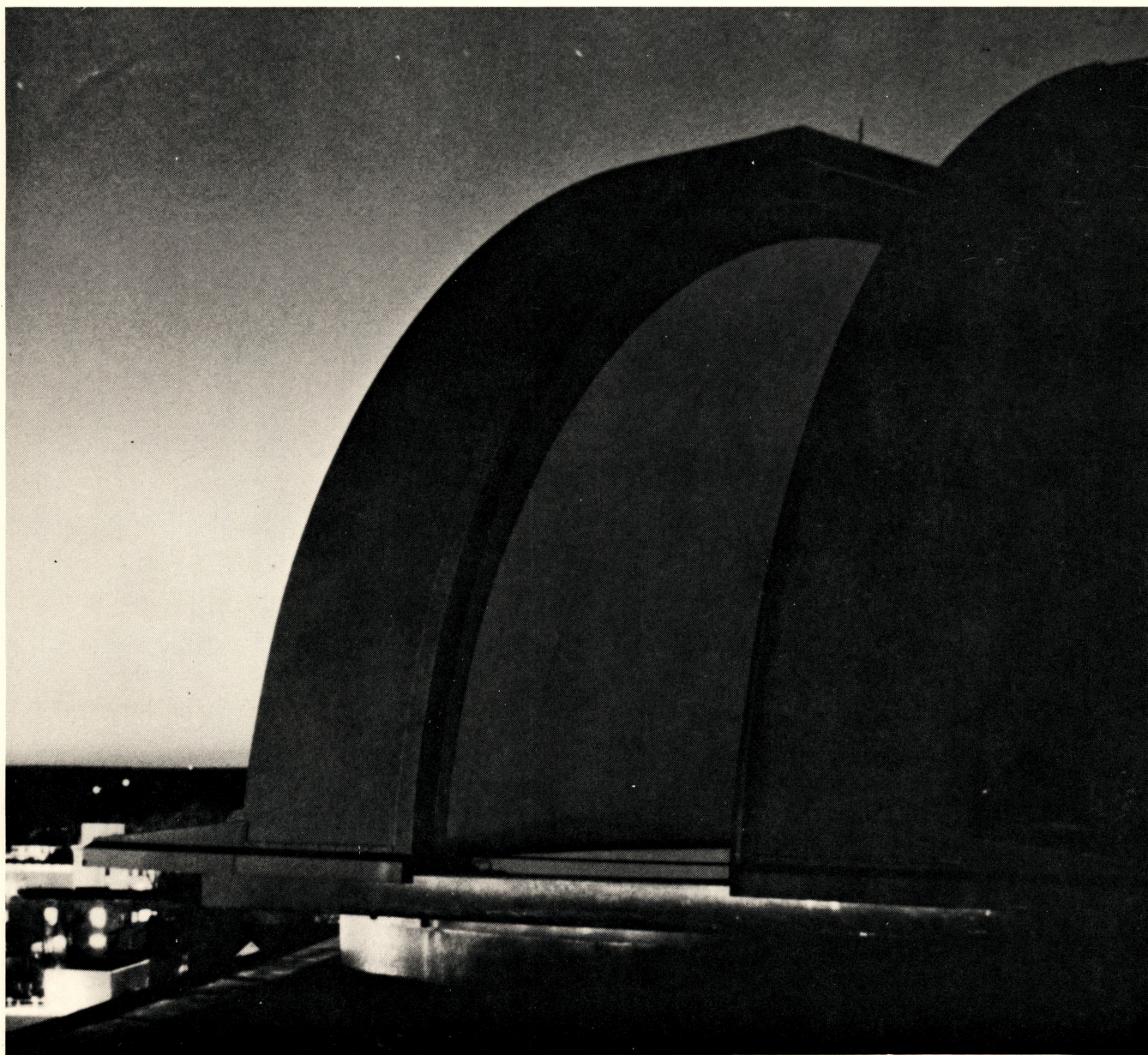


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Missouri Shamrock

The UMC College of Engineering Student Magazine



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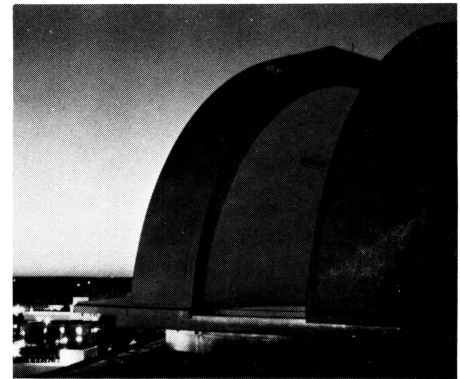
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Missouri Shamrock

The UMC College of Engineering Student Magazine

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The February cover depicts the Observatory of the UMC Physics Building. Read A View to the Universe by Kathy Ziaja. Photo by Phil Greene.

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The World Comes To Columbia

by Linda Kral

Columbia has a wealth of world culture at its disposal. The University has brought different cultures through students from around the world. Getting to know a foreign student allows you to become acquainted with a foreign culture.

I had the opportunity to speak with three foreign students in engineering here at the University. They shared some of their background, experiences, and goals with me and I will now share them with you.

Mohammad Shahidehpour was born in Tehran, Iran. At the age of 25, he is currently a PhD candidate and hopes to have this degree by March. What has led up to this achievement is many years of hard work and study.

Mohammad explained that Iran's school system is organized like the United States (12 years), but each student specializes in one of three areas at the high school level. These areas are math, natural sciences, and literature. Their high school doesn't offer as many alternatives as an American high school. Mohammad chose the math route which later led him into engineering. He finished high school, amazingly, in 11 years at the age of 16.

After finishing high school, Mohammad went on to college in Iran where he received his B.S.

degree in electrical engineering. He wished to continue his studies in electrical engineering with emphasis in power and, when reading an article in IEEE (Institute of Electrical and Electronics Engineers), found that UMC's electrical engineering department was ranked second in the nation in power systems. On this basis he chose UMC.

Mohammad came directly to Columbia from Iran in August 1977. One year later, August 1978, he received his Masters degree in electrical engineering. Now he is working on his PhD degree in electrical engineering again with emphasis on power systems. Obviously, Mohammad has been a dedicated student with goals set along his path of success.

According to Mohammad, in the freshman and sophomore level of the university, most of the textbooks used in Iran are translated into the Persian language. For the junior and senior level, however, textbooks are used in their original languages—specifically, rather than lose any technical meaning of the subject, books are not translated into Persian. After being a teaching assistant for one year, Mohammad feels that American students are hard workers and understand experimental concepts well, whereas foreign students are more theoretically oriented.

When Mohammad came to the United States, he had to adjust to living in a small city compared to Tehran, a city of six million people. He now likes Columbia and its size, but he misses his mother and father (who are both retired teachers after 32 years) and his sister in Tehran.

Besides studying, Mohammad enjoys talking with friends, going to the movies, or working out at the gym. He likes meeting people from all over the world. He finds it amazing and interesting that so many foreign students are here in Columbia and he wishes that American students would try to learn more about the world and other cultures.

After obtaining his PhD, Mohammad plans to work on his Post Doctoral or work in a U.S. company for experience before returning home to Tehran.

Mary Solberg is also from Tehran, Iran. She is currently a junior in electrical engineering and will graduate next December. She has now been in the United States for four years.

Before graduating from high school, Mary had taken 50 hours of math and 10 hours of physics and chemistry. Like Mohammad, Mary also chose math as her area of emphasis in high school. She explained that most high school students want to go to college, but

there aren't enough universities in Iran. She also stated the government of Iran pays tuition and housing costs. Mary was unable to get into the universities there, but had an American friend who had taught English in Iran. She was encouraged to come to the United States and decided on Kansas University.

One episode that Mary speaks of was when she returned home to Tehran with her future husband (who was also attending KU) for their marriage ceremony. However, after being married only four days, she and her husband became separated from each other for two months. Mary was unable to obtain a visa for two months while her new husband returned to KU.

Later Mary and her husband decided to transfer to UMC. She likes it here and feels that it is much easier than the universities in Iran. Mary's brother, who also attends UMC, received his bachelor's degree in engineering in Iran and finds his Masters degree here is easier to do.

Mary loves the United States. She feels it's a nice place to live and raise a family with no food problems. She likes the way, in America, that the whole family works and take care of themselves because in Iran it is the father's total responsibility. Women are not supposed to work due to religious beliefs. In her spare time, Mary

Kathy Ziaja



Mary Solberg

enjoys going to discos, movies, or cooking and spending time with friends. She feels Americans are sometimes too busily caught up in their own world, and should spend more time making friends.

Mary plans to go on with her studies here and obtain her Masters degree in electrical engineering. She then plans to return home with her husband and hopes to work in the factories in Iran.

Hasan Widjaja was born in Indonesia where he lived for nine years. He then moved to Malaysia for four years and is currently a resident of the Republic of Singapore. Hasan is a mechanical engineering student here and has been in the United States for three years.

During high school in Singapore, Hasan took courses such as general math and advanced math which consisted partly of differential equations. This enabled him to test out of Math 80 here. Hasan said he had to study hard in high school. After high school, he went on to junior college in Singapore where he studied general science. As there are only two universities in Singapore that are very hard to enroll in, Hasan looked elsewhere. He had a sister currently living in Kansas City so he decided to come to Kansas City and attend UMKC. After attending UMKC for two years, Hasan transferred to UMC.

Since the majority of people in

Kathy Ziaja



Hasan Widjaja

Singapore speak a dialect of English, Hasan has not had much of a problem with American English. He finds the United States universities much easier than in Singapore. Hasan is a member of Engineers Club and Pi Tau Sigma (the mechanical engineering honorary fraternity). Besides studying, Hasan enjoys jogging, lifting weights, and the martial arts. He also enjoys the freedom of speech in this country.

Hasan will graduate in May and then enter graduate school in the United States to obtain his Masters degree in mechanical engineering. Then Hasan plan to return home to Singapore.

These three students have shared part of themselves and their background with us. There are many foreign students in engineering and in other areas at the University. They have a wealth of culture to share with other students and would also like you to share your background with them.

Kathy Ziaja



Mohammad Shahidepour

Conversation

by Dave Wilkerson



Dr. Rex Waid

In this issue, CONVERSATION talks with Dr. Waid, professor of Electrical Engineering at Mizzou. Dr. Waid discusses many of his activities which give him a close involvement with Engineering students.

CONVERSATION: Could you first explain a little about yourself and how you became a professor.

DR. WAID: I guess I could have been classified as a professional student. I first went to a junior college for three years and then to William Jewell College for two years to receive a B.A. in Mathematics. After spending two years in Uncle Sam's Army I came to Mizzou where I completed a B.S. in Electrical Engineering in two years. I stayed in the department another year to get my Master's and it was at that time that I worked as a Teaching Assistant in the lab. I liked it so much that I was hired as an Assistant Professor in 1959 and I taught for four years. I then went to Wisconsin for three years to get my Ph.D. I came back here in 1966 and I've been here ever since.

I was about 33 years old when I got my Doctorate and I'm sure many people look at a person who is that old and in school and wonder if he's ever going to take a job and become productive. I had done summer work with various companies before, but I guess I sort of eased into the teaching profession by accident.

CONVERSATION: What activities are you involved with now?

DR. WAID: I guess I would classify myself as a student oriented professor since I'm involved in a lot of student activities. I'm director of the minority program in engineering at Mizzou. This often takes me out of Columbia, seeking talented minority students and then trying to get them involved with our program. Dean Morgan and I have been faculty advisors for the Society of Women Engineers for a number of years. For several summers I have coordinated a program for 25 to 30 outstanding high school students. They spend time in the classroom and also time with faculty members on research projects. Many of them eventually come to Mizzou. I've also been responsible for organizing and managing the engineering tutoring effort on the third floor of the Electrical Engineering building.

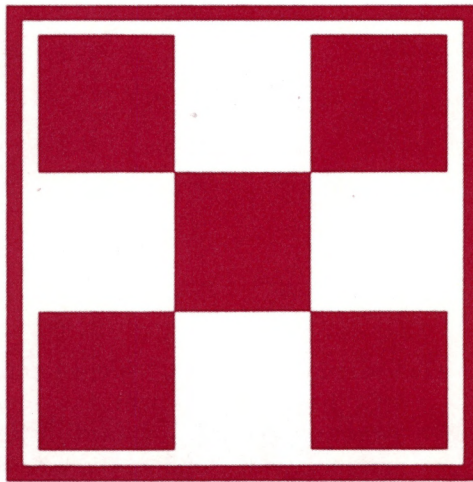
With all these activities, it's been difficult to maintain an active research program. However, I look at the engineering faculty as sort of a team where individual members have particular strengths. As long as the members fit together and complement one another so that the college is successful, then everyone should not be expected to do all things extensively. I think we have an administration that is supportive of this philosophy and I guess I've made a conscious choice to try to do a decent job in the classroom and be involved in student activities.

CONVERSATION: Could you explain more about your activities with students and why you are involved in this area?

DR. WAID: We have a lot of students over to our house. I would imagine that over a year's period we probably have at least a dozen or more events there. We like to do this and I have found that a personal involvement with students means a lot to them.

I basically like people to have fun. I think college should be a fun experience. I like to see students do well academically, but not to the exclusion of extra-curricular activities. I have lunch with interviewers from many companies and most of them would far rather have a 3.2 student who is involved in a lot of extra-curricular activities than say a 3.7 student who shows no involvement in non-academic areas.

I probably have a reputation of not being serious and taking things too lightly. But I think that is only an outward picture I'm painting. Inwardly I'm a very serious person. I may joke with a student and appear to be somewhat frivolous but this is just my way of trying to keep him/her from being so uptight. The bottom line is that I am truly concerned with their overall welfare and usually bend over backwards to assist in any way possible. Besides being remembered as one who does a decent job in the classroom, I want to be remembered as a professor who takes interest in the total individual.



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A Special Learning Alternative

by Tom Sapienza

Senior level "300" project courses can both be an interesting and practical means of familiarizing oneself with similar projects performed in industry today. These project courses are, however, quite dissimilar to the average lecture or laboratory course in that one endeavors to complete a given experiment relating to an on-the-job task.

Project courses usually require five conditions to satisfactorily complete the experimental work. First, one must inquire about current projects yet to be completed by a professor or graduate student in a variety of discipline areas. Second, one must submit a form at the time of pre-registration to the Dean's office and obtain the signature of the professor and the departmental's undergraduate advisor who approves the course for credit (normally three credit hours are given for these courses). Third, one needs to procure necessary background information concerning the area of the project which provides oneself with adequate knowledge to undertake the task. Fourth, a completed written report is required to be submitted and approved by the professor and the undergraduate advisor. Fifth, if the work is not completed by the end of the semester (which it is taken) a delayed grade will be given until

the required work is completed.

One such project was completed the Winter semester 1980 by Bill Britt, an electrical engineering student. He performed an experiment on Digital Image Processing. Digital image processing consists of producing a quantized or discrete image from a television camera and viewer. The discrete values of the image are specified by spatial coordinates and brightness levels, which can be conceptualized as rows and columns of a matrix. The rows and columns are correlated as points of the image while the equivalent matrix is correlated with the brightness levels. The matrix elements are referred to as pixel picture elements while brightness levels are referred to as gray levels.

The amplitude value of a function to be digitized at a spatial

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point indicates the brightness of the image at that point. Color images require three function combinations for three fundamental colors. A light intensity function at a point has both an incident and reflected component and a brightness component.

Peaks and valleys of the image are referred to as light and dark areas, respectively an abrupt cut-off in the image indicates a border boundary while smooth areas suggest levels of constant brightness.

Discrete values are found for the


spatial coordinates and gray levels, which digitizes the signal. Spatial coordinate determination is performed by image sampling. Discrete values for the brightness levels are the gray level quantizations. The resolution or picture definition depends on the number of sampled pixels and discrete tray levels. The minimum numbers of square pixels and gray levels are 256 x 256 and 64, respectively.

The system consists of a television camera and display screen, video digitizer, a large memory computer to store the image bits and a DEC 11/50 computer. The hardware was constructed for the provision of removing disk packs for program storage and data, while core Graphics made up the software. The core Graphics sub-system contains programs to handle each device and maps it onto a single virtual plane by superimposing a plane containing the graphics information. This type of process is available using subroutines from Fortran programs. The more common types of digital image processing are pseudo color, heat and acoustic imagery and enhancement and edge contrast.

Some of the advantages to enroll in a projects course include the following list: a student's acquaintance with present industry laboratory research, the learning of experience is not time-restricted, the exposing of the work with professors and graduate students and written reports provide invaluable experience to the student.

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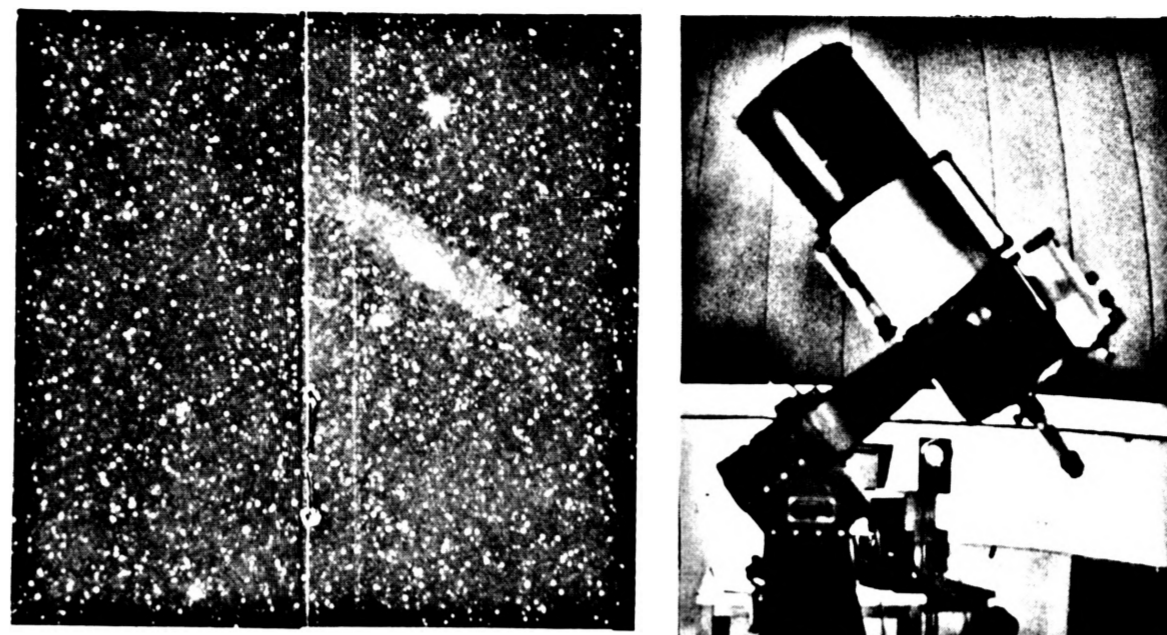
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A View to the Universe

by Kathy Ziaja

Galaxies become visible through the campus eyepiece in Laws Observatory.



The major telescope at Laws Observatory—its magnifying power ranges from 50X to 500X.

Kathy Ziaja



Night time from atop the Observatory.

Laws Observatory, on the roof of the Physics Building, is one of UMC's hot-spots on clear, Friday nights. Many star-gazers consisting of students, Columbia residents, and out-of-town guests visit the facility.

Observing the more common objects, which include the moon, planets, open star clusters, globular star clusters, double stars, and nebulae, many questions are asked and answered concerning the universe. The more distant objects, such as the external galaxies, are difficult to observe visually from this location of the Observatory, due to lights, haze, and air currents of Columbia.

However, the Physics Building has definitely not been the only location or Laws Observatory the only Observatory at UMC. The original Observatory was founded by Professor Hudson in 1853. Hudson later became the third President of the University. In 1880, President S. S. Laws provided the funds to enlarge the original facility and to move the Observatory

building to a site on the northeast side of the old campus. The Observatory was named in his honor, and when Neff Hall was constructed in 1919, the observatory was moved to a third location. Later, this site, too, was needed for other construction and, therefore, the present Observatory was opened on the roof of the new Physics Building in 1967.

The major telescope at Laws Observatory is a Schmidt-Cassegrain optical design which was manufactured by the Celestron Corporation. Its optical system consists of a 16-inch diameter primary mirror, a convex secondary mirror, and a thin glass aspheric corrector plate. These are all optically matched to give the effective focal length of 180 inches in a compact tube, which is better protected from vibrations.

Depending on the eyepiece used with the telescope, magnifying powers range from 50X to 500X. The lower magnifications, however, give

better results in the urban seeing conditions of Columbia.

The telescope is electrically driven at the sidereal rate to compensate for the Earth's daily rotation. The dome housing the 16-inch instrument is rotated to position the slit properly for the object being viewed. In addition to the main telescope, there are two auxiliary 10-inch Schmidt-Cassegrain telescopes. These are mounted outside on the Physics Building roof.

Nashville, Mo., he had, at best, a 6th grade education and finally paid a school to teach him so he could enter college. After receiving a BS degree and a Masters degree in astronomy from UMC, he obtained his PhD from Princeton and later, in 1920, was appointed Director of Harvard College Observatory. After serving 30 years, he had made it into the nation's top-ranked astronomical college.

Although, presently, there are 20 faculty members in the Department of Physics and Astronomy here at UMC, only two are astronomers, Dr. Terry Edwards and Dr. Charles J. Peterson. There is also a new Archeo-astronomy course in the making, possibly to be offered Fall Semester '81. This course will cover astronomy's relation to ancient civilizations and its influence on their society.

At UMC in the 1920's, there was a budget cut in science. Peterson explained that one of the things that allowed

astronomy to survive was surveying and measurement techniques used by engineers.

Though used for mostly religious purposes in past times, astronomy may be applied in many different ways today. With advancements in technology, the universe is becoming more accessible to everyone, and is an integral part of our daily lives.

The tradition of opening the UMC telescope facilities to the public during the school year dates back to the era of Professor Ficklin in the 1880's. The telescopes are available to everyone; perhaps in the future UMC will acquire a larger telescope and locate it at a better observing site where more distant objects may be viewed.

It is a rewarding experience to anyone who has not yet seen the Milky Way, a satellite passing by, or even a telescope, to visit Laws Observatory and view the universe.

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The UMC Tradition Lives

by Michelle Morris

Engineers Week—a 78 year old Mizzou tradition that always brings good times and happy college memories.

Most sources claim, and it is generally agreed, that St. Patrick was 'discovered' to be an engineer in 1903. Who actually made this discovery is still a mystery. At least four UMC graduates have declared themselves responsible. Like scientific discoveries and inventions, it is quite possible that these individuals made their 'discoveries' simultaneously. With classes six days a week, surely several overwrought, spring-fever infested minds saw St. Pat's Day as a much needed holiday. The connection was obvious. St. Patrick drove all the snakes from Ireland. Snakes are akin to worms and all mechanical engineers are familiar with worm drives (a spiral gear commonly found on adjustable wrenches). Of course, St. Patrick accomplished this miracle with various 'switches'. Needless to say, St. Patrick was proclaimed the patron saint of all engineers and the entire 1903 class celebrated the event by skipping class

on March 17.

Unfortunately, classes were not the only things cut. Several grades suffered and a student or two found themselves expelled. Undaunted, the yearly celebrations continued and the professors began to humor the engineering antics. By 1905 these wild imaginings had produced a Blarney stone, found in the excavations for a new engineering annex, and a visit from St. Pat, himself. The day's folly began in front of Booches, where the students gathered to escort the saintly old gent to the steps of the engineering building. Here, the saint blessed his loyal followers and knighted the worthy seniors. The day then ended with a St. Pat's dance. As the years went by, the march from Brooches to Engineering was elaborated into a full-scale parade and the knighted ceremony honored outstanding faculty and staff as well as students. Cleverly, the students won

approval by including the faculty in their frolics.

Today, this one-day of bull-arney has blossomed into a week of scholastically unfruitful activities. The typical Engineer's Week might begin with the Road Rally. For those who think they can follow a maze of directions, a prize awaits them at the finish line. Monday brings the ping-pong ball drop and faculty fun and frolics. Hopefully this year, the March winds will blow just right and the ping-pong balls will land in the Francis Quadrangle. These ping-pong balls can

(Continued on page 20. See TRADITION.)

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Take Every Book That You Own

by Craig Meyer

*Information that can help you prepare
for the Engineering-In-Training Exam.*

In less than three short months, many seniors will graduate from UMC with engineering degrees. They will finally see the fruits of several years of hard labor. They will, at long last, be admitted to the engineering profession. They will not, however, be professional engineers.

Becoming a professional engineer involves more than getting an engineering degree from an accredited engineering school. In the state of Missouri, that's just the first step. The second step is passing the Engineer-in-Training Examination on the fundamentals of engineering, which can be taken after graduating or in the twelve months preceding graduation. The third step is acquiring four years of approved engineering experience. After completing these three requirements, the prospective professional engineer may take a second examination, commonly called the PE exam, on the principles and practice of engineering. All of the above requirements must be fulfilled before a candidate is eligible to apply for registration as a professional engi-

neer, except in special circumstances.

But why should a graduating engineer worry about professional registration? After all, the job market seems to be strong for any kind of engineer, regardless of registration. Registration is important for several reasons. Registration carries with it the legal ability for an engineer to practice engineering in his or her own right, and it is a legal requirement for many engineering positions. "Registration is somewhat more important for those students planning on going into consulting than for those planning on a manufacturing career," says Dr. Robert M. Eastman of the Industrial Engineering Department. Nonetheless, registration is a mark of respect even among engineers in manufacturing, and it is becoming more important because of the increase in product liability suits against manufacturing firms. In fact, bills are pending in many legislatures to require all practicing engineers to be licensed.

The EIT exam is usually given twice a year in Missouri, in the fall and in the spring. This year the exam will be conducted on April 11 in Columbia, Rolla, and St. Louis, and again on October 29, in Jefferson City. Those wishing to take the exam on April 11 must send an application and \$10.00 to the Missouri Board for Architects, Professional Engineers, and Land

"The exam consists of a four hour morning session and a four hour afternoon session.

Those wishing to take the exam on April 11 must send an application and \$10.00 to

*Missouri Board
P.O. Box 184
Jefferson City, MO
65102*

by February 26.

Surveyors, P. O. Box 184, Jefferson City, MO 65102, no later than February 26. The deadline for applications for the October 29 exam is September 14.

The exam consists of a four hour morning session and a four hour afternoon session, which carry equal weight. Missouri uses a standard test printed by the Educational Testing Service and distributed by the National Council of Engineering Examiners (NCEE). According to Roger Stricklin of the NCEE, the standard test is used in every state except Illinois, and Colorado. Once registered in one state, an engineer usually has no trouble getting registered in other states, says Stricklin, although these cases are

(Continued on page 20. See EIT.)

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During his senior year, the engineering student is confronted with two distinct choices:

One or several companies will offer the student about \$20,000 a year to accept a job in private industry. They will fly the student to the plant or corporate offices, paint vivid pictures of challenging, interesting job responsibilities, dangle enticing fringe benefits before the prospective employee, show the student dazzling new equipment and computers, and generally make the student feel like

program has avoided a sharp decline only through increased international enrollment. Foreign students comprise fifty percent of the graduate program, and the program hungers for more US students.

Despite the decreasing valence of graduate education, valid reasons exist for continuing with graduate work. Engineering careers have a tendency to start strong, peak early, and grow slowly thereafter. Engineers may start at \$20,000, but stop at \$30,000. Not a bad salary,

classes in Kansas City.

This introduces another set of options for the engineer: obtaining a masters degree either at night school or by returning to full-time study after a few years in industry. Dougherty cautions against night

“UMC offers many combined masters degrees programs. Talk to your department head for advice and direction on these options.”

Options in Graduate Study

by David Scott

a worth while human being.

The Graduate Engineering School will send the student a form letter. This letter urges the student to ignore the financial feast prepared by employers and to endure at least one more year of financial impoverishment, professors and extensive course material. All the student must do to receive yet another no-expenses-paid year in Columbia, Missouri is to complete the required forms and plunk down the required tuition.

Lately, an increasing percentage of American students are opting for the first selection. Nationwide, graduate engineering enrollment is falling while the number of international students in our graduate programs is increasing. This results in a sharp reduction in US students receiving graduate education. At UMC, graduate engineering enrollment has increased slightly while undergraduate enrollment has exploded, and the graduate

but also not a great deal better than a union machinist or an automobile assembly line worker, and they didn't spend four years in college fighting thermodynamics and calculus. A graduate degree in engineering or business can give the engineer the credentials needed for continuing career development.

Graduate degrees are important for design jobs and research and development positions. A recent IEEE survey discovered that fifty percent of design engineers possessed an advanced degree. At research organizations such as Bell Laboratories, masters degrees are essential and PhD degrees are strongly urged.

Jim Dougherty, Senior Engineer at Western Electric in Kansas City, cites his masters in electrical engineering as a major reason he was able to advance to the level of senior engineer early in his career. Dougherty obtained his masters degree from UMC in 1972 by attending two years of evening

school for two reasons. First, attending evening classes for several years while carrying full-time job responsibilities is a grinding routine and the attrition rate is high. Second, evening programs tend to be less rigorous and competitive than full-time programs, and employers are aware of this deficiency.

Returning to school after experience in industry is a strong alternative. However, it is difficult to sever employment and financial obligations for school. This process can be facilitated if the company is willing to give an employee assistance in returning to school, but typically only the larger, high-technology firms are eager to boost the employee in full-time study.

For those interested in a masters degree at UMC, the procedure for admission is easy. If your undergraduate GPA is above 3.0, fill out some forms and you're in. For those whose GPA's fall between 2.5 and 3.0, you will need to obtain some letters of recommendation and the school will counsel with you before you are accepted. If your GPA is below 2.5, your chances of being admitted are slim. Taking the GRE test is another requirement.

The engineer's choices for graduate study are certainly not
(Continued on page 20. See GRADUATE)

The Steam Tunnels of Campus

by Tom Ziaja

The quadrangle is a familiar sight to UMC students. Underneath, however, is a world seldom noticed. Steam tunnels run to every building on the red campus, tunnels that carry a myriad of pipes. Joined to the other end of the tunnels is the UMC power plant. Bill Brown is the plant superintendent.

The power plant is impressive. Six floors, from basement to roof, it produces one-half of the electricity and all of the steam for the university campus. The University has a contract with the city of Columbia, whereby it purchases approximately one-half its needs from them. In emergencies, the agreement works both ways with either the city or the power plant supplying the other with electricity. The demand for power is year round, but peaks during certain times of the year. Winter, for instance, is the largest load period, mainly for heating buildings on campus, but summer still sees heavy loads for air-conditioning and electricity. In September, the average steam output was 4,770,936 lbs. per day. This amounts to slightly below the 7,000,000 lbs. per day attained during peak periods. The mean temperature per period of time is seen, then, to be the single greatest factor affecting plant output. The output increases as the mean temperature decreases because demand for heating increases.

Producing this energy in the form of steam and electricity requires a fuel, and coal is the staple diet for the power plant. Gas is occasionally used to fire the boilers, but coal is burned to produce the power. The plant uses Illinois coal shipped in by rail. But, how

Responsible for providing warmth to dormitories and classrooms is the underground labyrinth of the power plant's steam tunnels. How the power plant produces its steam is the subject of Tom Ziaja's article.

Pictures by Phil Greene.

the coal is used to produce energy is what the plant is all about.

The first and most important step in the production of power is the boiler. There are four boilers through which the steam is produced. The power plant's boilers are of two designs, chain grate and spreader stoker. Each of the two chain grate boilers has a fuel bed of coal, 6 or 7 inches in height, that feeds it. As this bed passes into the boiler, the coal begins burning, with the most intense flame where the bed enters the boiler. By controlling where air is injected into the burning fuel bed, the intensity of combustion may be controlled. As a result, the bed near the end of the boiler is burnt, and the bed just entering is burning the most. On opening the side view doors on the boiler, flames can be seen at one end with relative inactivity at the other.

In contrast to the chain grate boiler, the two spreader stokers function in a different way. In these the fuel is thrown or fanned into the boiler and burnt in suspension. The fire is more

intense and the heat greater in the spreader stoker because more surface area of coal is available for combustion at all times than in the chain grate. Looking in on this fire, billowing flames can be seen on both ends. On the outside of the boiler, the coal chutes are visible and the paddle arms wave back and forth, spreading the coal into the boiler and stoking the fire within.

The steam is produced. At a temperature of about 320°F degrees and at a pressure of from 290 to 400 pounds per square inch the steam leaves the boilers. To extract energy, the steam is then sent through a turbine which produces the electricity via a generator. The power plant has three turbines, with rated capacities of 750kW, 5000kW, and 10,000kW. Only one of these turbines can take the steam at its highest pressure, the other two designed for operation at the lower pressure of 290 psi. When the steam passes through one of

(Continued on next page.)

(Continued from page 17)

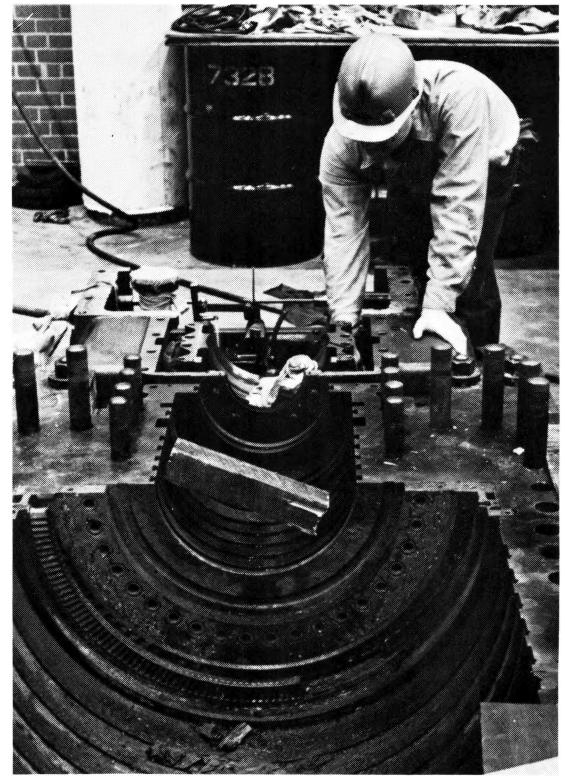
the turbines, the heat and pressure are converted into electricity. As the energy is removed by expansion of the steam against the turbine blades, the temperature drops, as does the pressure. The energy removed is now in the form of electricity and is sent out to the campus. By the design of the turbines the steam leaving is at a pressure of 60 psi, and contains enough energy to heat campus buildings, where it is now sent.

To get to the campus, the steam travels through steam lines—large insulated pipes. These pipes carry the steam to dormitories, classroom and other buildings on campus for use in heating, and for other uses such as in chemistry labs. The steam lines are mostly in concrete ducts underground, but up to the Memorial Union the lines are carried in a tunnel. This steam tunnel begins at the power plant, as do the other steam lines, and goes to the Union, underground. Along the way, tunnels branch off to the red campus.

One problem with the steam in the steam pipes is hot water coming together with steam. Called a water hammer or water knock, it pops and cracks in the pipes. This is the sound sometimes heard from the gratings in the sidewalks on campus.

After passing through radiators on campus, the condensed steam, called condensate, flows through condensate lines. These lines run along side the steam pipes, leading back to the power plant. Here the condensate enters one of two condensate receivers. A pump then passes this condensate on from each receiver to two of four condensate polishers. Each polisher has a resin base that filters iron out of the condensate. The rust comes from the iron pipes the steam travels through, and if not filtered out can cause problems. Without filtering, the rusty water travels through the boiler pipes and slowly deposits rust in them. The rust deposits form scales. Since steam is a cooling medium for the boiler pipes and the scales prevent proper cooling, the pipe overheats at the scaled area and a blister develops. If the rust is not removed, less steam can be produced per pound of water. "Preventive maintenance is

The turbine base serves to channel steam.



the secret to the operation of the power plant. If you have a failure, somebody's going to get cold." Brown says.

From the polishers, the water travels to an operator, then on to a feedwater heater. Here, the water is heated to a temperature of 107° C and pumped to the boiler. Alternately, some of this water passes through another feedwater heater and is heated to 140° C before going to the boiler.

The water has completed its cycle.

There are still more steps in this production process. Some of the steam is excess coming from the turbines and not used for heating. At 60psi, though, it cannot be returned directly to the boiler. That is where the cooling tower on top of the plant comes into play.

Coming from the turbines, the excess steam passes through a condenser which cools it down to water. It is then pumped into the aerator and rejoins the cycle. To condense this steam, however, the condenser must have cool water. This cool water forms a separate cycle from the steam production cycle. After condensing the steam, the cooling water is pumped to the top of the power plant at 8500 gal/min and allowed to fall, cooled by the atmosphere. Once cooled, it is again used in the condenser as cooling water for the excess

steam.

Inevitably, water is lost going through the various cycles. With a condensate return rate of 70-85 percent, there is a makeup rate on water of 15-30 percent. All of it comes from university wells. There are four wells, each about 1100-1250 ft deep, located around campus. As could be expected, one is at the power plant itself. The others are at the reactor, near the General Services building, and just north of the vet complex. Two of these wells average 500 gal/min each and two 1000 gal/min each.

When adding raw water, as the makeup water is called, to the steam

Public Utility Engineering

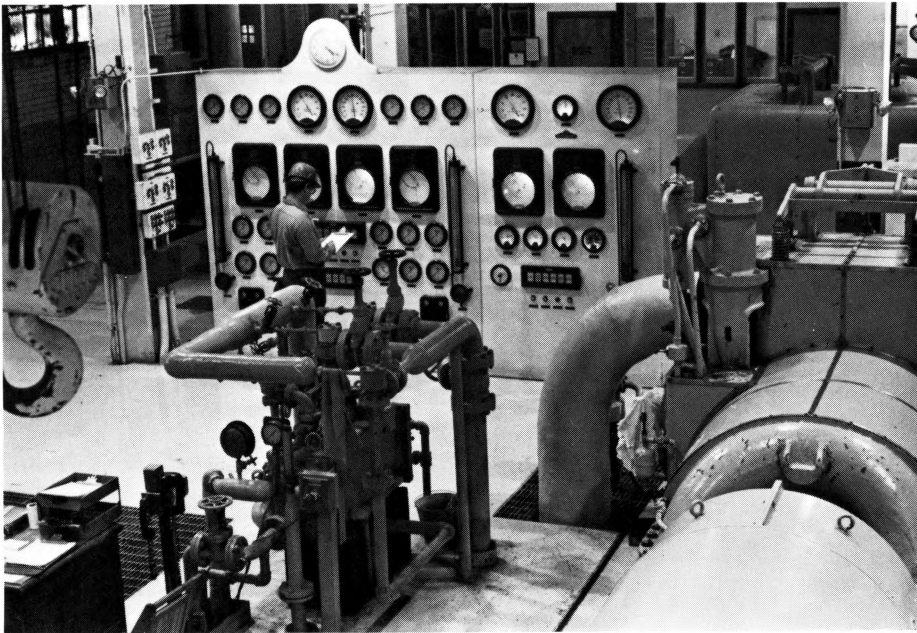
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The Control Board in the power plant monitors steam temperature and pressure. The three long tubes on the panel are mercury barometers.

cycle it must first go through raw-water polishers before joining the cycle at the aerator. This raw water, tested weekly for purity, is the same as the campus drinking supply.

One subject passed over so far is what to do with the exhausts from burning the coal, since Illinois coal at 2 percent Sulfur is used. The new chimneys are designed to help alleviate this problem by dispersing exhaust particulates over a wide ranging area, decreasing the concentration of ground-level pollution. And, in 1980, bag houses, which are nothing but vacuum cleaners, were being installed to help clean the exhaust of pollutants. In the bag houses are teflon bags about eight inches in diameter by 30ft long. These bags catch exhaust particles. The exhaust from the boilers passes through the bags to breacher (ductwork) to booster to chimney, and is released into the atmosphere. The booster is nothing more than a fan. Since the boilers operate at a low discharge pressure, adding the bags creates an obstacle to the exhaust and the booster compensates for this by helping the exhaust along.

The particulates trapped by the bag houses, and the cinders from the burnt coal, are not wasted. Used on snow and ice by the state highway department, the use of the cinders is an efficient use of a waste product.

Producing this power costs money. Typically, about \$4 per 1000 lbs. of steam. This is from the cost of Illinois coal at approximately \$52 per ton, and an annual use of approximately 85,000 tons. Because of the addition of the chimneys and bag houses, more Missouri coal will be used; at a higher Sulfur content, 3.85 percent, it is cheaper at \$30/ton. Missouri coal is desirable over Illinois coal for this reason.

Back in his office, Brown talks about the plant trips classes have made to the power plant, and of what an educational opportunity the plant is for engineering students. And the chance to see first hand what the students read about, and to actually look inside a boiler. The university should recognize the value of the plant to its students' education, and use the plant for education, too.

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(GRADUATE from page 16.)

limited to engineering. Law, medicine, and business are open to those with bachelor's degrees in engineering. Masters of Business Administration (MBA) degrees are popular for engineers, and they prove valuable because engineering has long been an intelligent route into management. UMC offers many combined masters degrees programs. Talk to your department head for advice and direction on these options.

The 1981 MBA class at Stanford University, one of the nation's top business schools, is comprised of 20 percent engineers and only 10 percent business majors. At M.I.T., thirty-three percent of the students in the Accelerated MBA program hold engineering degrees. An engineering degree coupled with an MBA gives an individual almost unlimited opportunities for career development.

When applying to graduate business schools, the applicant should start early. Admission procedures to the better MBA programs require taking the Graduate Management Admissions Test (GMAT), transcripts from all undergraduate institutions attended, letters of recommendation from several sources, and completion of extensive application forms, most of which require response to several essay questions.

Graduate education is an effective springboard into a wide variety of careers, and it is an excellent method of removing barriers to career advancement. The current shortage of graduate students means the future demand for these individuals will be intensive. For those completing bachelor's degrees, huge entry level salaries should not blind the student to opportunities available in graduate school.

(EIT from page 15.)

handled on an individual basis.

The morning session of the exam consists of 140 multiple-choice questions from thirteen subject areas, such as electrical circuits, fluid mechanics, mathematics, and thermodynamics. No notes or books are usually allowed on this part of the exam, although a battery-operated hand calculator is permitted. The afternoon portion of the exam contains 100 questions, in nine subject areas, 70 of which must be answered. Questions in each of the subject areas may appear in problem sets ranging from two questions per set to ten questions per set. This part of the exam is also multiple choice, but books and notes are allowed. When asked what books to take for this portion of the exam, Mike Hudgins, a chemical engineering senior who took the exam this past fall, replied, "Take every book that you own."

(TRADITION from page 14.)

be redeemed for prizes donated by local merchants—anything from a free soda to a steak dinner. The student-faculty fun and frolics is everyone's chance to realize some extremely well-hidden talent. On this night, favorite professors as well as the Assistant Dean of Engineering can be found live on stage. Tuesday night, the five queen finalists practice for the Queen Skits, slated for the following night.

Engineer's Club begins the queen selection process and all of engineering completes the process by voting for one of the five fianlists. Much of this decision rests on the candidate's performance during the Queen skits.

Thursday night, students, faculty and staff can find all the food and drink they can handle at the Engineer's Barbeque. Musical entertainment is also provided. Friday brings the Knighting Ceremony and the Honors Banquet. Saturday complete the week with a parade through town, the Alumni

Luncheon, Green Tea at the Chancellor's home, and St. Pat's Ball.

Also spread throughout the week is such competition as the beard growing contest and calculator contest. Other more intellectual events include Professor-for-a-day and lab exhibitions. Former UMC students return to campus to share some of their work experiences during professor-for-a-day and lab exhibits feature anything from digital imaging to concrete canoe construction. All these activities, hopefully, provide something for everyone.

The exact times and places of Engineer Week events will be posted in the Engineering building and advertised in the campus papers. So, if March comes in like a lamb, beware—it is bound to go out with a roar. After all, this is where it all began and the UMC engineers have 78 years of tradition to uphold.


See page 22 for EIT exam-
ple problems



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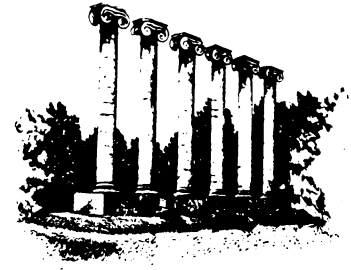
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CONSULTING ENGINEERS

West of the Columns

by Tom Ziaja



The Placement Center for the College of Engineering is next to the engineering dean's office. Assistant Dean Jack Morgan is director of the center, which is open to all students. As he said, though, the center doesn't find a job for you. A student can't go in and say, "Place me in a job." Instead, the center's function is to create the opportunity for prospective employers to meet students, and for students to meet the employers.

The operation of the center is simple for the student. Prepare a data sheet—often called a resume—and leave it with Lou Baur, secretary in the placement center. She handles all the paperwork and develops the scheduling for interviews. Copies of the data sheet are made and kept at the center. The copies are given to the interviewer and to you, if you need them.

Sign up sheets for interviews are hanging on the wall next to the dean's office. To sign up, place your name in an available time slot for the company you wish to interview with. Usually it will state on the sign-up sheet what the company is looking for. Usually, only graduating seniors are wanted for permanent employment. However, check the sheets for indication of summer job openings. Even if there is no indication of summer job availability, there may still be openings. The company may be waiting for you to make the first move. Companies act differently; some interview for summer jobs directly, while others depend on contact by initiative.

To make the first move, check the sheet for the company of interest to you. If it states summer, you're set. If no mention is made, or if graduates are specified, wait until the last day of the sign-up time period, about 10 days. On the last day, there will most surely be one or two openings in awkward time slots. Sign your name up, placing "summer" after it. You have given seniors 10 days to sign up, so you shouldn't be bumping a senior. And the company will like your initiative.

Once you're in the interview itself, certain things heighten your appeal to the interviewer. Grades are the first indicator to the company. The higher the grade point average, the better your chances. The grade point mainly gives your interviewer a basis from which to

start. As the interview progresses, the individual's assets are weighed collectively, and grades may be either elevated or dropped in importance.

The people who get the most,

When grades and activities have been checked from your data sheet, the interviewer turns towards talk and observation to get a personal opinion of you in the interview. You want to corroborate the interviewer's good impression of you from your data sheet. To assure the best impression during the interview, pay attention to appearance. "Even if you're a junior, go like you're a senior. Dress conservatively," says Dean Morgan. "Dress in your 'Sunday suit', your best clothes. No sport jackets. The impression you make with your appearance is the first impression an interviewer has of you personally. Make it count!"

Show you know about the company and what you want to do for them. Be as specific as you can. During your junior year, at the latest, check the literature available on the ground floor of engineering below the dean's office. This literature is provided by the companies that interview here at UMC. Learn about the different companies available to you major.

Using the placement center resources, you can meet companies personally, rather than having your application by mail get lost in the shuffle.

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EXAMPLE—Thermodynamics

Steam is compressed in a closed cylinder from 20 psia and 400° F to 40 psia at constant temperature. Find the work per pound.

The relation between P and v is not known for T=c path. Steam does not obey the ideal gas law. Therefore, we must convert the integral of Pdv to something involving property changes which are independent of the path. Use the first law for closed systems:

$$q_{1-2} = w_{1-2} + u_2 - u_1$$

$$T(s_2 - s_1) = w_{1-2} + (h_2 - P_2 v_2) - (h_1 - P_1 v_1)$$

make a table of properties:

	1	2
T	400°F	400°F
P	20 psia	40psia
v	25.43 ft ³ /lbm	12.628 ft ³ /lbm
h	1239.2 Btu/lbm	1236.5 Btu/lbm
s	1.8396 Btu/lbm °R	1.7608 Btu/lbm °R

$$-67.8 \text{ lbm} = w_{1-2} + 1236.5 - \frac{(40)(144)(12.628)}{778} - 1239.2 + \frac{(20)(144)(25.43)}{778}$$

Therefore, $w_{1-2} = -65.7 \text{ Btu/lbm}$

EXAMPLE—Electrical Circuits

If power is being dissipated in a circuit element at a rate of 500 watts and the current is 10 amps, what is the voltage across the element?

$$V = \frac{P}{I} = \frac{500}{10} = 50 \text{ volts}$$

EXAMPLE—Engineering Economics

A typical credit union charges 1% per month of the unpaid balance on all money borrowed. This is a nominal interest rate of 12%. What is the true effective interest rate?

ANSWER

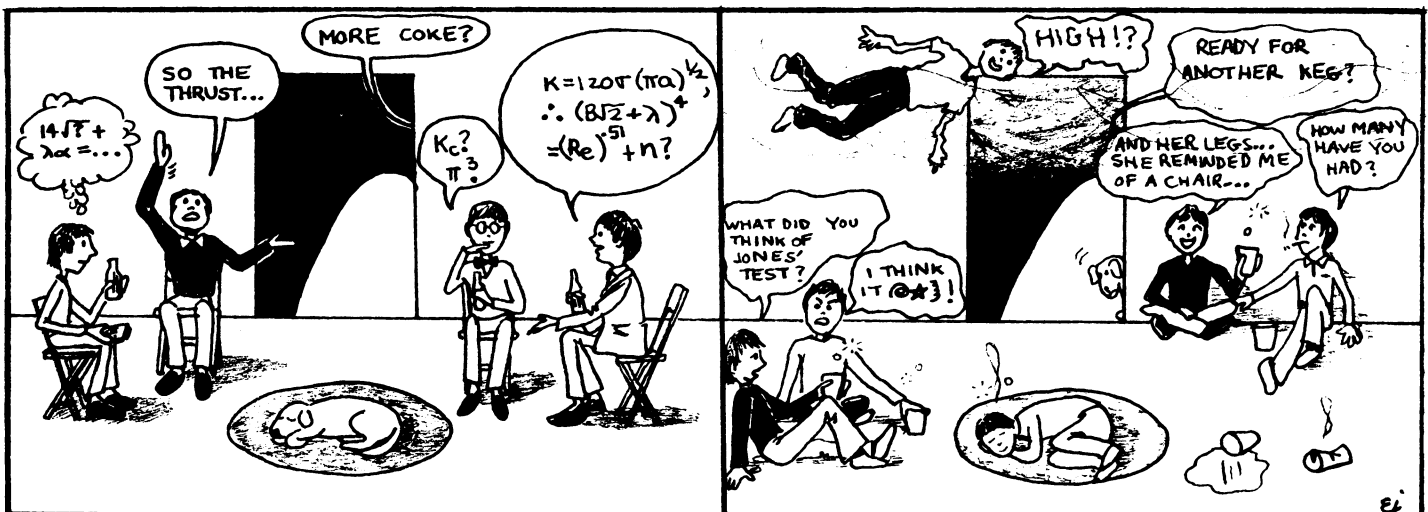
In one year there are 12 monthly payments, "n" = 12, and the monthly interest "i" is 12%/12 or 1% as stated.

Assume \$100 is borrowed and no payments are made for 12 months. The amount owed would be

$$F = 100(F/P, 1\%, 12) = 100(1.126825) = \$112.68 \text{ which is equivalent to a true effective interest rate of } 12.68\%.$$

(Examples taken from THE RUST ENGINEERING COMPANY EIT REVIEW, Third Edition, edited by Thomas H. Springfield, Ph.D., Copyright 1975, by permission.)

The Engineer Party



A Business Student's View

An Engineer's View



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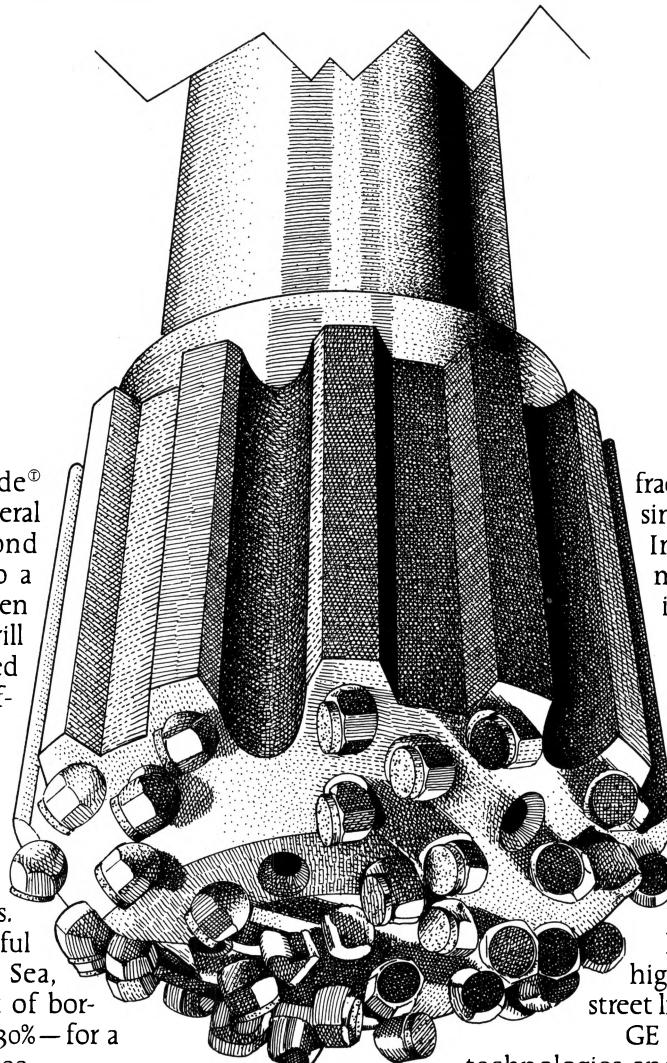
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With this drill bit, GE is putting diamonds back into the earth.



The diamond is Man-Made[®] diamond developed by General Electric. Man-Made diamond crystals are pressed into a polycrystalline "blank." When this blank is attached to drill bits like the one pictured here, it provides a highly efficient cutting tool to probe deep into the earth.

Drill bits which include diamond blanks can as much as double the penetration rates of steel bits in drilling for oil and gas. In one of the most successful applications in the North Sea, these drill bits cut the cost of boring through shale by nearly 30%—for a total saving of close to \$300,000.

Two remarkable engineering breakthroughs were required for the development of these drill bits.



The polycrystalline diamond blank microfractures because of its structure. Natural cleavage planes of mined diamond (right) cause it to break off in larger pieces.

First came the synthesis by GE of Man-Made diamond itself. Pioneering the technology of heating and pressurizing carbon established

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Then GE invented the technology which compacts the small, powdery Man-Made diamond into far larger disks (as large as 12 mm. in diameter by as much as 1 mm. thick). Since these disks are composed of many nonaligned crystals, they resist the massive destructive

fracturing which occurs in large, single-crystal natural diamond. Instead, these disks tend to microfracture, constantly exposing new cutting edges without destroying the diamond product.

Creating new engineered materials is an important example of research in progress at GE. Recent developments include a proprietary epoxy catalyst that's cured by ultraviolet light. GE work in ceramics led to the Lucalox[®] lamp—a highly energy-efficient form of street lighting.

GE is constantly investigating new technologies and innovative applications for existing technologies—in such areas as electrical distribution systems, electronic components, environmental systems. This takes talent—engineering talent—not just in research and development, but in design and manufacturing, application and sales.

If you are interested in engineering opportunities at GE, check your Placement Office or write to: Engineering, Bldg. 36, General Electric, Schenectady, New York 12345.

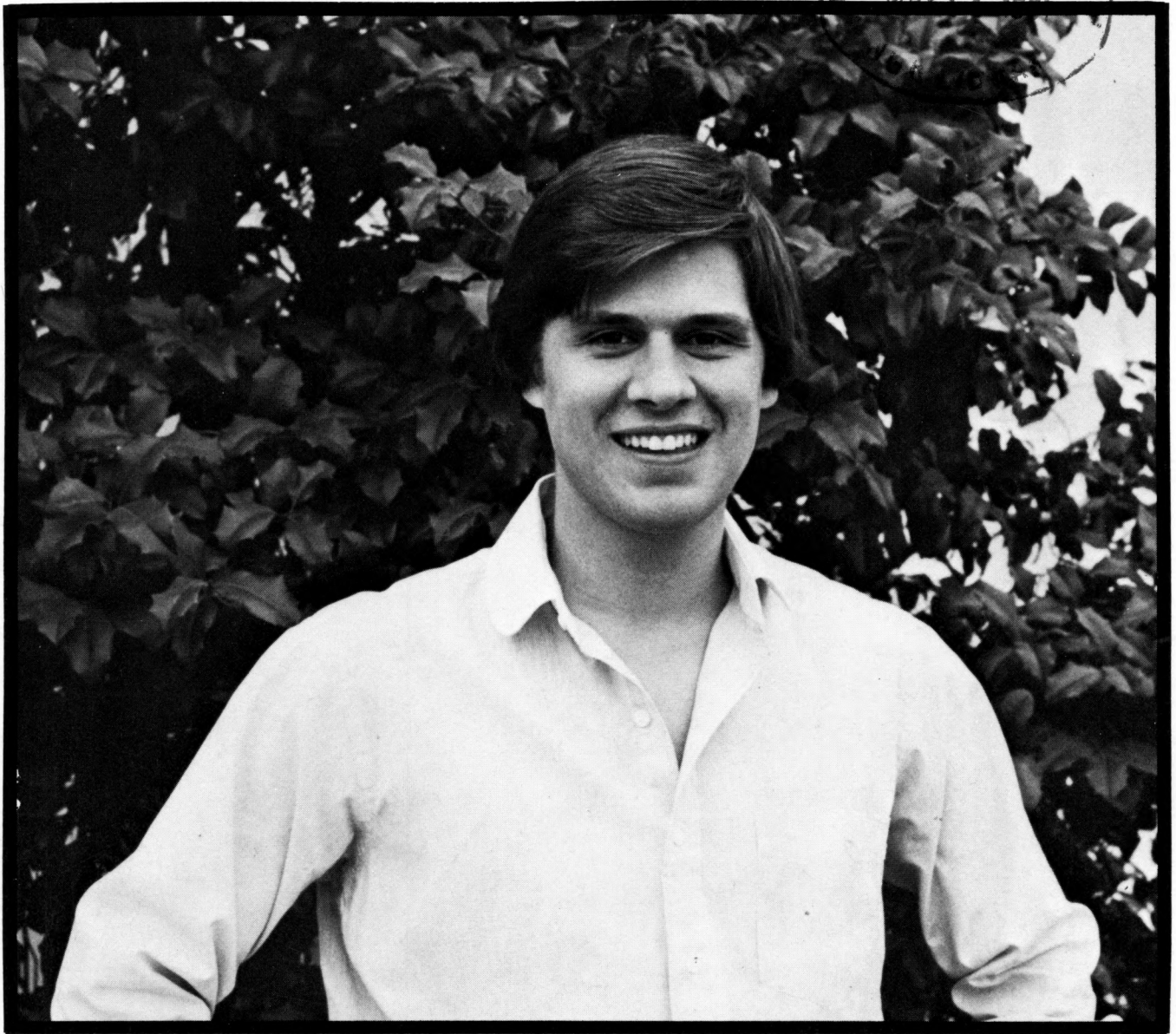
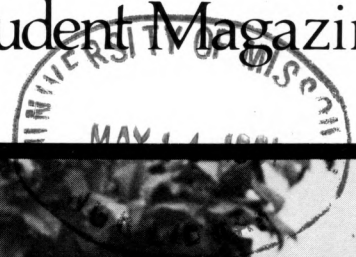
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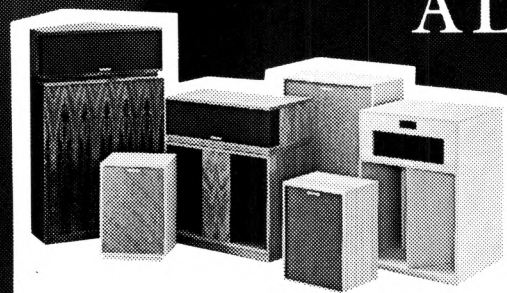
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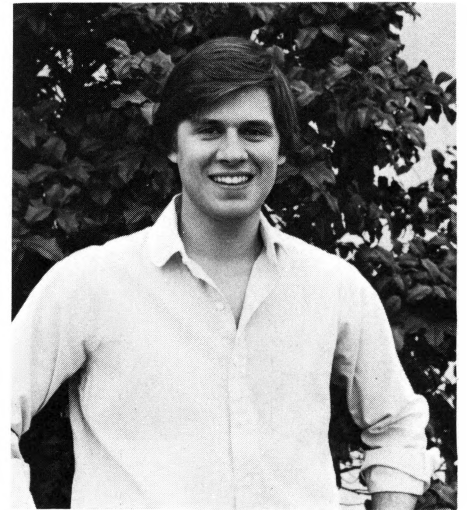
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Missouri Shamrock

The UMC College of Engineering Student Magazine

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Don Massey was crowned the 1981 Engineering King. Photograph by Kathy Ziaja. Also in this issue is a story on the physics cartoonist by Jim Bartley.

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Foremost, the *Missouri Shamrock* gratefully acknowledges its advisor, Ms. Margaret Kraeuchi, Director, Engineering Communications.

"Energy from Heaven and Earth"

by Laura Miller

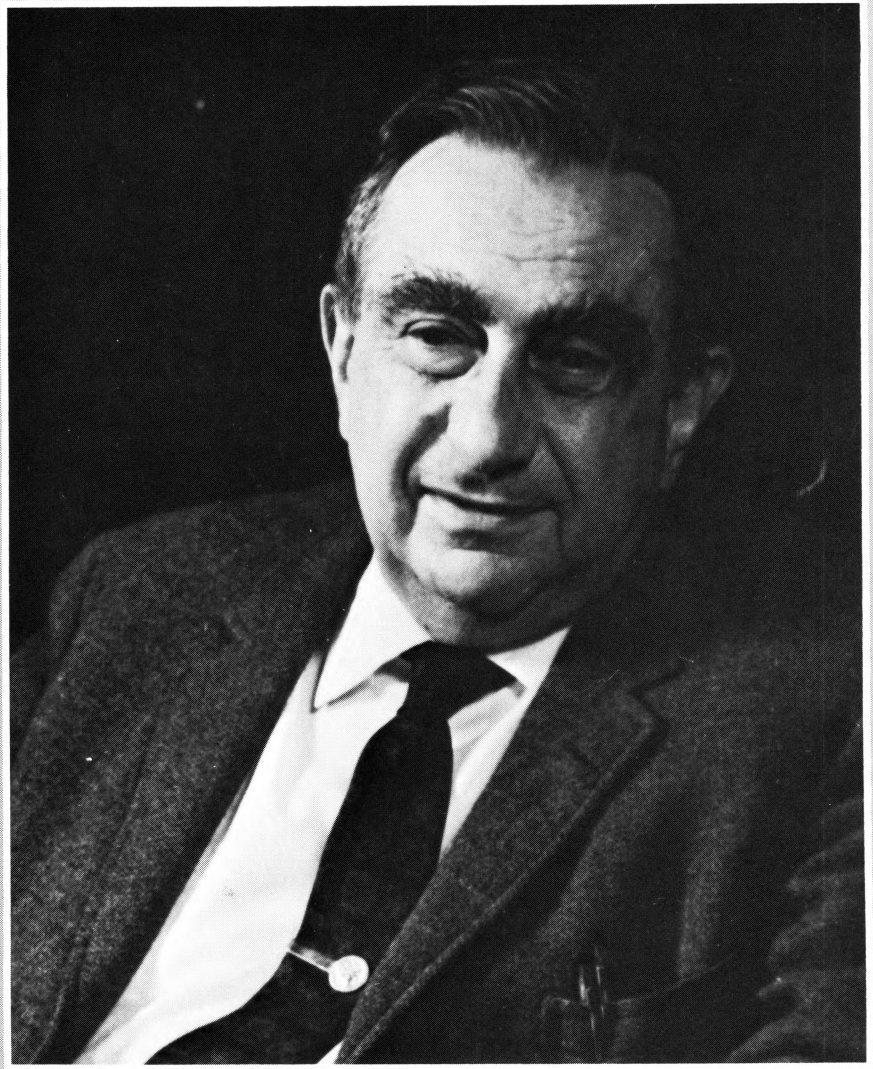
In recognition of National Engineers' Week, the Croft Lecture series presented physicist Edward Teller.

Dr. Teller spoke candidly on energy alternatives, the Soviet presence in Afghanistan, and his personal involvement with the development and use of the atomic bomb.

Dr. James Beauchamp warmly introduced Dr. Edward Teller as "born in Hungary . . . and bearing a striking resemblance to Zsa Zsa Gabor" to the capacity audience in EE auditorium on February 20, 1981. Originally bestowed by a Kansas State student, this is Dr. Teller's favorite introduction.

Senior Research Fellow at Hoover Institution at Stanford University and a consultant to Lawrence Radiation Laboratory (which he founded after World War II), Dr. Teller was the guest speaker for the fourth annual Croft Lecture series. Dr. Teller was a physicist with the Manhattan Project, at the request of President Franklin Roosevelt in 1942. His work on this project enabled him to make major contributions to the development of both the atomic bomb and the more powerful hydrogen bomb, and he now plays important roles in the peaceful uses of nuclear weapons and safety measures for nuclear energy.

"Energy from Heaven and Earth" was Dr. Teller's theme; the title refers to his call for the world to explore all possible energy alternatives. He supported the lifting of the oil price ceiling and the stopping of government involvement in synthetic fuels. "Coal can be turned into oil. Oil shale can be turned into oil. When the government does it . . . it will cost \$70 a barrel because it is done in an inefficient



way by amateurs, by people who have been selected for political reasons and not their engineering skills. The same thing can be produced by the oil companies but for . . . an estimated \$40 a barrel."

Dr. Teller then spoke of the "continuing menace . . . And that is that the Soviet Union has managed to encircle the Persian Gulf." He believes the Soviet invasion of Afghanistan will ultimately lead to a Soviet conquest of the Gulf, "When the Soviets decide to move, we won't be able to stop it. And from the Persian Gulf comes 45% of the oil which the free world is consuming." Dr. Teller's peaceful alternative to survival without the Persian Gulf oil requires the use of severe contingency plans. These contingency plans should be made now and would force the country to devise ways to deal with the possible shortage. The shortage would mean more than turning off the air conditioner, it would create "unemployment and practically an economic collapse" but would not be nearly as terrible as a war, "a war we will lose."

He further advises building more nuclear reactors of the same type the country now uses. He pointed to the 200 regulated electricity generating reactors that have operated, on the average, for the past ten years. If the reactors nearing completion were to be licensed and unnecessary restrictions removed, he

suggests the United States could cut imported oil needs by 1,000,000 barrels a day, or \$10 billion annually.

On the problem of nuclear waste disposal, Dr. Teller mentioned a feasible method. The nuclear fuel can be placed at the bottom of a 30' pool of water for some years (there is some debate whether to leave the fuel for four or forty years). Then, reprocess and remove the reusable elements. What then remains, bury in a dry, stable area at a depth of a few thousand feet. After 300 years the radioactivity decays to a safe level.

In reference to the dangers of uranium mining, Dr. Teller commented: "Every mining operation is dangerous . . . if you want to produce the same amount of energy, uranium mining is 1 to 2% as

dangerous as coal mining."

Near the end of his lecture, Dr. Teller fielded questions from the audience. In particular, one student questioned Dr. Teller's participation in the atomic bombing on Hiroshima and Nagasaki. Dr. Teller answered: "It was a mistake to drop the bomb on Japan. At the time the bomb was dropped I was 37 years of age. I was against it but there was nothing I could do about it." In his 1967 address at Notre Dame University, Dr. Teller had voiced a similar message, "We could have exploded the bomb over Tokyo at a safe altitude and done nothing more than shake a few windows. We could have demonstrated in a wonderful way that man's technical ingenuity can stop a most horrible war."

The Coming Impact of Technology on Music

by Mike Wroble

The future museum-goer may be able to “walk” through computer simulations of ancient Rome or 19th-century London, much the way airplane pilots in training “fly” into simulated airports. An “electronic palette” that allows the computer artist to “paint” on video and produce work that seems to have been made by oils, watercolor, or pen and ink has recently been developed by CBS-TV and the Ampex Corporation. At M.I.T., Professor Nicholas Negroponte plans to research “drawing with your eyes”. He envisions wallsized displays that will change as the viewer gazes at them. Holographic and stereo television, videodance, optical digital audio discs read by a laser beam, and other exciting technological advances are anticipated in the not-too-distant future. In the years ahead, modern technology is likely to have a profound effect on music, dance, theatre, and the visual arts in ways that can only be guessed at in 1981. This article will shed some light on what’s in store for the most communicative of all arts, music.

Technological breakthroughs, the kind that force consumers to replace their old equipment, are rare in the record-playing business. Extra-hard needles, metal tape, time-delay units, dynamic range expanders, and a lot of other esoteric add-on equipment have been marketed in recent years with varying success. About 30 years ago, stereophonic sound was

introduced and everyone agreed it was an advance that made monaural systems obsolete. The quadraphonic sound system of a few years ago was a flop, mainly because consumers could not justify paying a lot of money for what was considered very little improvement in fidelity. Up until the advent of digital technology a couple of years ago, the rule for recording sound was this: the pattern recorded should be an analog of those rapid variations in air pressure that the ears and brain interpret as “sound”. Although progress in the analog realm has been remarkable, the inherent problems with the analog-recording principle remain. Limitations of tape-motional stability in the recorder and of magnetic nonlinearity in the tape conspire to guarantee that none of the continuous amplitude variations shall be captured perfectly.

Digital recording, however, abandons the whole idea of a one-to-one copy of reality. It begins by imposing a set of limits—on frequency response, on dynamic range, and on distortion, for example. Within those pre-established limits, it is capable of doing a far better job than any analog technique. Digitally mastered discs that can be played on a standard record player have already come out, but the question on everyone’s mind now is when true home digital-disc playback will be a reality. There are at least four

(Continued on page 14.)

Tailoring Engineering for Your Career

by Craig Meyer

Engineering is a very good field for someone who wants a good job after four or five years of college. Companies are scrambling to offer jobs to graduating engineers in areas such as research, development, design, and manufacturing.

But what about the student who wants to go to medical school? Shouldn't he major in biology or chemistry? And shouldn't the pre-law student major in political science or history. And isn't a bachelor's degree in business or economics the best path to an MBA?

Not necessarily. Dr. John Rouse, chairman of the Electrical Engineering Department, says, "An engineering degree is an excellent first degree for someone wanting to go into business, law, or medicine." He also says that the electrical engineering curriculum is set up to provide maximum flexibility for students wishing to go into areas such as these.

In fact, flexibility is a trait common to all the degree programs in the College of Engineering. "Through the elective portion of our program, a person wanting to go into law, medicine, or business could work in several courses in that area. For example, a person interested in business could take a three-course sequence in economics to fulfill the humanities/social sciences requirement. And we could probably find room for five more hours of business courses, for a total of fourteen hours in the area," says Dr. Paul Braisted, chairman of the mechanical engineering department.

In order to benefit fully from this flexibility, however, a student must choose his electives carefully. He

(Continued on page 10.)



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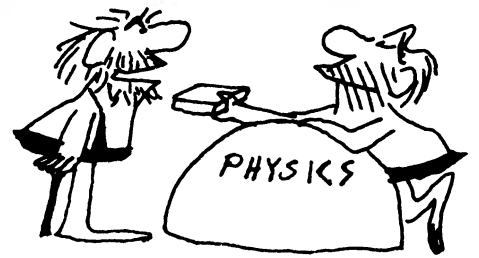
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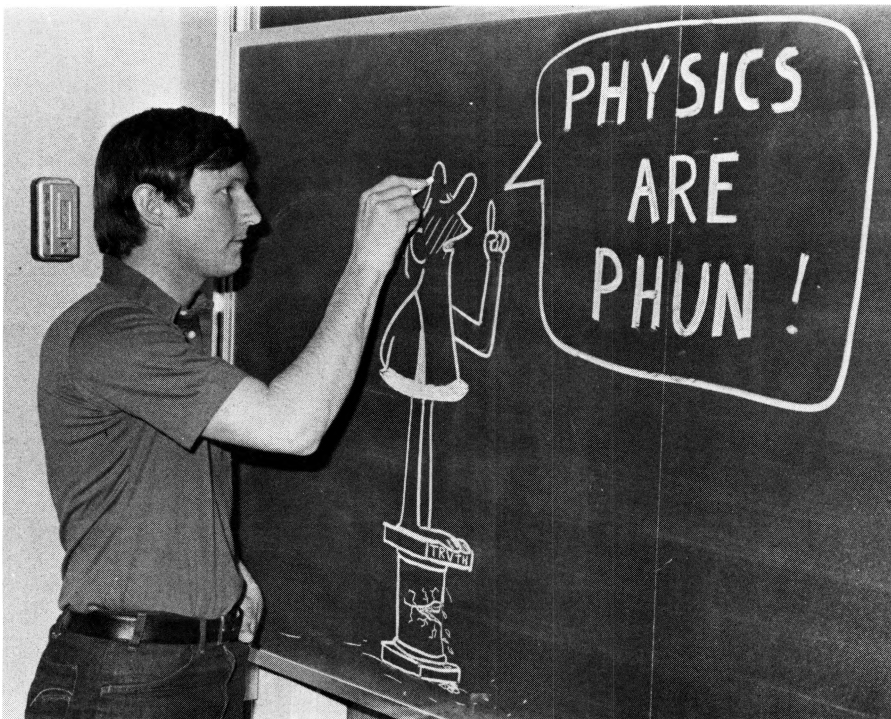
THAT TEST WAS
EASY. I BET I
GOT AN "A" FOR SURE.



Philip Chumbley—

He makes Physics Fun

by Jim Bartley



By no means trying to upstage creator Johnny Hart, Phil Chumbley freehands the famous "BC" characters to bring humor to physics.

Sincere thanks to Rich Stehnack for his photograph.



AAAA
RRRG
GGHH

"B.C." cartoons have begun to play an important role in Physics. The characters from "B.C." have frequently appeared on the chalkboards of the main Physics lecture room and have helped to add the spark of humor which physics often lacks. Although Johnny Hart, the creator of "B.C.", is not on campus, UMC is fortunate to have Philip Chumbley, a Physics graduate student and part-time cartoonist.

Chumbley became interested in "B.C." while in high school and with the aid of his brother, started collecting "B.C." paperbacks. He has only been drawing "B.C." for two years. He says it all started one evening when he was with a girlfriend and "with nothing better to do we started drawing cartoons," Chumbley said. Since that night, Chumbley has become an exceptional cartoonist who can bring a chalkboard to life in less than 20 minutes.

Although Chumbley has gotten in some hot water for punning other academic degrees in his cartoons, his drawings

have been well received. Chumbley often checks with Drs. Hensley, Schupp, or Tompson and tries to keep the cartoons pertinent with class subjects.

Chumbley is an easy-going and humorous person with a smile that could melt the terror from a Physics 124 final. Originally from Ludlow, Illinois, Chumbley received his undergraduate degree from the University of Illinois. He then enrolled in graduate school at UMC to do research in X-ray scattering effects.

Chumbley has been very active in activities other than his research work. He coordinated the remodeling of the T.A. and graduate lounge in the Physics building. The lounge is furnished with dark wood paneling and lush carpet. Chumbley is working on a capacitor switch lamp, which turns on at the wave of a hand, and a motorized coffee table, which will be installed in the

near future.

Chumbley plans on continuing his quest for a doctorate degree in Physics and new ways to incorporate "B.C." into physics. If anyone has ever wondered how the 8' x 5' chicken got perched on top of the Physics dome last April Fool's Day, just ask Phil. If you thought the chicken was great, stop by Physics on April 1st because "you just ain't seen nothin' yet!"

should consult with his advisor about his plans as early as possible in his college career, especially if he wants to go to medical school. Medical schools have specific course requirements that a student must fulfill to be considered for admission. For example, the pre-med engineering student should take Chemistry 11 and 12 (General Chemistry) instead of Chemistry 5 (Chemistry for Engineers).

Required and recommended courses differ from one school to the next. Dr. Jay Goldman, Industrial Engineering Department chairman, says, "If a student knows what (graduate or professional) school he wants to go to, we recommend that he go to that school and ask them what courses he should take."

Dr. Goldman also says that the Industrial Engineering Department

recently developed a dual master's degree program with the UMC business school. In this program, a student can earn a master's degree in business administration and a master's degree in industrial engineering in the same amount of time it would normally take to earn the MBA alone. This would normally be about two years if the student takes the proper prerequisites as an undergraduate.

Following are some possible electives that the pre-law, pre-med, or pre-business student might take. These lists do not include all of the courses that a student might want to take, and some graduate schools might recommend or require courses other than these.

Possible Electives for a Student Interested in Law

Acct 304	Managerial Accounting Concepts
Acct 305	Financial Accounting Concepts
English 50	Creative Writing: Short Story
Mgt. 254	Introduction to Business Law
Mgt 255	Legal Aspects of Business Organization and Operation
PolSci 210	Current Issues in American Politics
PolSci 306	Municipal Government
PolSci 309	International Law
Speech 75	Introduction to Speech Communication
Speech 276	Persuasive Speaking
Speech 374	Persuasion

Possible Electives for a Student Interested in Business Administration

Econ 41	Principles of Economics
Econ 241	Theory of the Firm
Econ 229	Money and Banking
Mgt 202	Fundamentals of Management
Mgt 310	Personnel Management
Mgt 311	Collective Bargaining
Mgt 329	Organizational Behavior
Mgt 375	Management Policies and Problems
Mark 204	Principles of Marketing
Acct 304	Managerial Accounting Concepts
Acct 305	Financial Accounting Concepts

Possible Electives for a Student Interested in Medicine

Bio 1 & 2	General Biology
OR	
Bio 11	Introduction Zoology
OR	
Bio 21 & 22	General Biology
Bio 213	Comparative Anatomy of Vertebrates
Chem 11	General Chemistry
Chem 12	General Chemistry
Chem 210	Organic Chemistry
Chem 211	Organic Chemistry Laboratory
Chem 212	Organic Chemistry
Chem 213	Organic Chemistry Laboratory
Anatomy 202	Elementary Anatomy
Phys 201	Elements of Physiology

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Research in Heart Treatment

by Ann Boman

Much research is conducted all over the nation. The research conducted can be anything from how many people eat eggs for breakfast to how the brain functions in human bodies. It occurs anywhere from the basement of a home to an expensive laboratory. At the University of Missouri Health Sciences Center, Dr. John C. Schuder and Dr. Jerry Gold are involved with research pertaining to the heart.

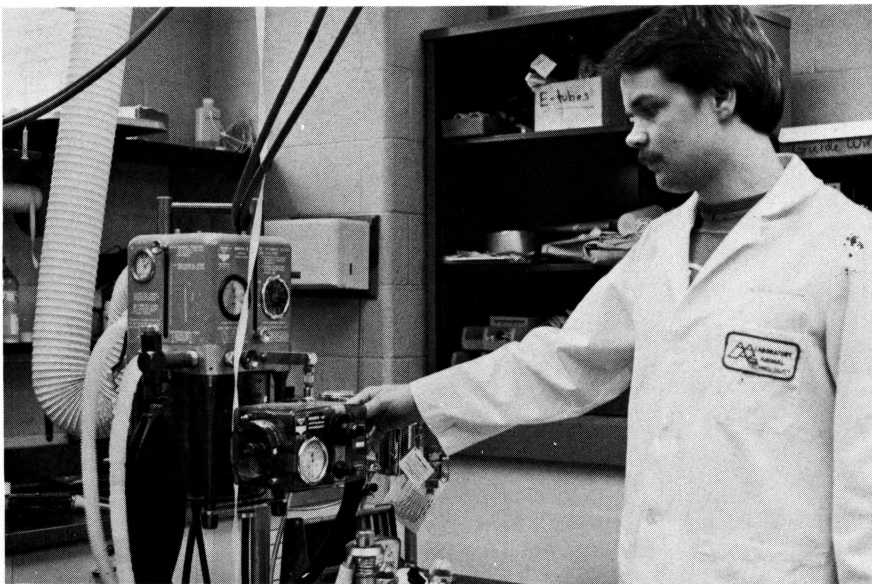
The heart is a fascinating and complex creation. It is the lifeline of the human body. When working correctly, blood is pumped throughout the body. Many things, however, can go wrong where this does

not occur. One such disorder is known as ventricular fibrillation. The human body can only withstand approximately four minutes of untreated fibrillation without damage to the heart, brain, and other vital organs. The only practical means for restoring normal function to the heart is a process known as defibrillation.

Defibrillation is accomplished with a machine that has electrodes which are placed on the patient. A shock is applied to restore the normal beat of the heart. Two main types of defibrillation are direct and transchest. Direct defibrillation involves placing the electrodes directly on the heart. It is usually used after open heart surgery. In the more common type of defibrillation, transchest, the electrodes are placed on the closed chest and the shock is applied.

Defibrillatory research is conducted at Research Park. The subjects used are dogs and calves. The way dogs' heart react to defibrillation may be more like human hearts than calves' hearts. With the research conducted up to now, the success rate has been somewhat higher in dogs than in calves. Twenty to twenty-five kilogram dogs shocked by a twenty-two ampere current for four milliseconds resulted in a ninety-nine to a hundred percent success rate. The highest success rate for the calves

(Continued on page 15.)



Kathy Ziaja

A heart defibrillation machine that may someday SAVE many lives

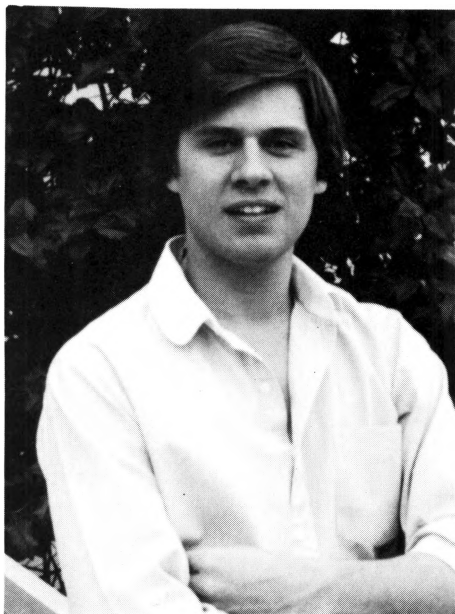
The Birth of a Tradition

by Laura Miller

Now in its second year, the Engineers Week King Contest may well be on its way to establishing itself as a UMC tradition. This year, eleven candidates were nominated from various engineering technical societies. From that field, six finalists were chosen, with each finalist performing a skit during Faculty, Fun and Frolics night. Votes were cast at the end of the evening and the winner was announced at the

barbeque. Don Massey was proclaimed Engineering King and awarded two tickets to St. Pats Ball.

Konda Oberlander, of the Society of Women Engineers, organized the king drive. She assembled a committee, distributed entry forms, and planned the king interviews. "I think that it was really fun. It will be a tradition that will be around and will gain more prestige," she said.



Don Massey

Don is a junior in agriculture engineering. President of ESC, he is "real proud to still be in the college of engineering, considering the attrition rate it has."

Engineering 5 was one of Don's favorite courses. During his king skit, he "coached" one of his "basketball players" to enroll "do-do loop" paper, referring to Dr. David's learning tool in the class.

Generally, Don respects teachers he has had, and he will miss the guidance they provide. One of his comments regarding industry was "you are thrown in to it and you don't even get an advisor."

Paul Adam

Paul Adam decided to major in industrial engineering initially because of job availability. He was quoted as not "regretting the choice." Sponsored by Alpha Pi Mu, the IE honor society, Paul was the first candidate to perform his king skit. He presented his version of "The Engineer Strikes Back."

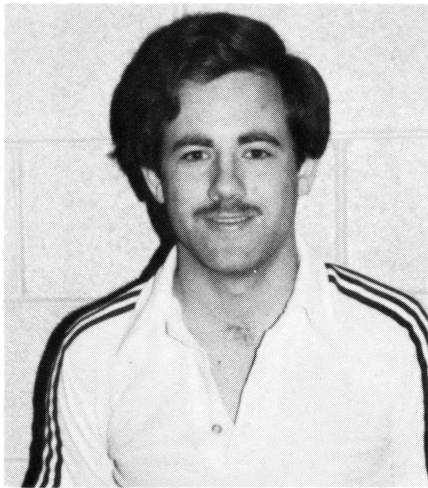
College has helped Paul appreciate other people's privacy. He has continued to enjoy dorm life for four years because he "felt the need to help underclassmen adjust to being on campus."

Paul's pride was "finding where my classes were at."

David Wilkerson

Representing the Missouri Shamrock was senior IE Dave Wilkerson. He portrayed Sir Lancelot of Camelot and rescued Dean St. Pat Morgan and Lady Guinevere (Michelle Morris) from the evil aggies as his skit.

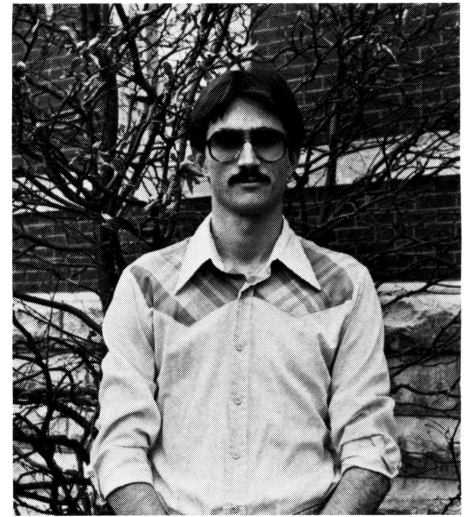
Dave is engaged to be married this summer. He looks forward to "a change, getting married and being a working man." Dave values his Christianity and forming good relationships with people."



Paul Smith

Paul anchored Weekend News Update for the Monday night FF&F. The third senior IE in the competition, Paul was nominated by AIIE.

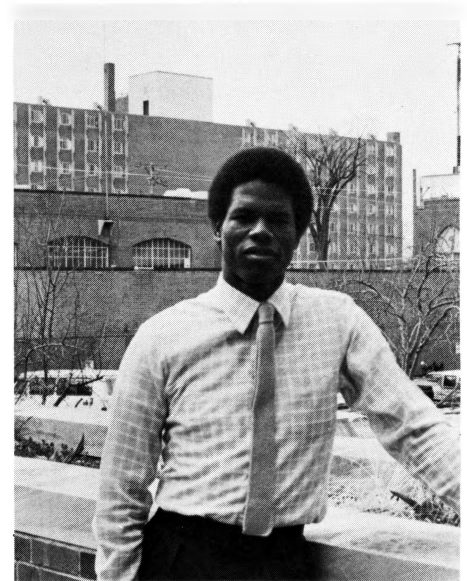
Paul would like to be remembered for "accomplishing some good things", such as helping three or four students stay in school. He hopes to achieve happiness with his life and looks forward to a "career of working with various types of people."



Mike Melton

Mike performed a solo act for his FF&F skit. He sang to the Beach Boys recording of *California Girls*—changed, of course, to *Engineering Girls*. He sang by himself because, as he told the Monday night audience, "no one would be in my skit!"

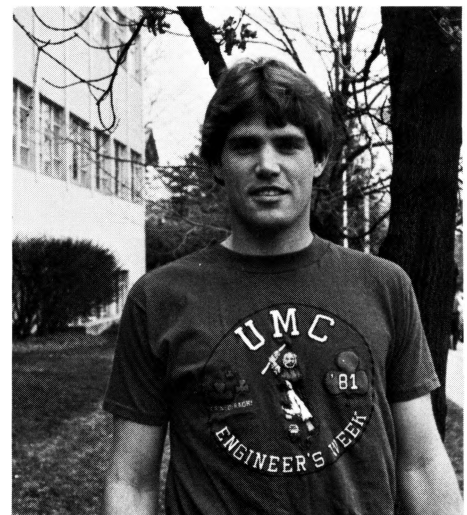
Mike, a senior in EE, believes that "college has disciplined me, it has taught me to accept faults that I have." Mike wishes that he would have modified his engineering curriculum to include a law emphasis, stating "I hope to go to law school some day."



Bob Morrison

Bob Morrison was nominated by AICHe as a "surprise"—meaning he was not at the meeting when nominations were discussed. Bob is active in intramural sports and will take a job as a chemical engineer when he graduates this May.

Bob was last seen imitating God. Although a courageous gesture, God sought revenge by bestowing the crown to another candidate.



photos by Kathy Ziaja

digital-audio systems in the works. Sony and Philips plan to introduce their jointly developed Compact Disc system in the fall of 1982. This will happen whether or not there is an international agreement on a digital-audiocdisc standard. Since Sony has close ties to CBS and Philips to Polygram, one of the world's largest record conglomerates, hopefully there will not be the standardization problems that have plagued video technology recently.

James Goodfriend, music editor of *Stereo Review* magazine, has complained about the misuse of technological developments. Somehow, after the invention has been invented there is no one around whose job it is to ask, "What are we supposed to do with it?" When quadraphonic came out the record companies released records with music that did not exploit the advantages of quadraphony. Now, with the advantages of digital recording, one would expect a raft of recordings with extended quieter sections. Instead, CBS, for example, came out with four of the consistently loudest pieces in the repertoire. As digital technology graduates from the demonstration stage and settles down, maybe record producers will get a little wiser.

The first step in the development of electronic music took place in 1948 in France, at the studios of the French National Radio. Sounds were tape-recorded, then altered mechanically or electronically, and finally combined into organized pieces. The technique is known as *musique concrete*. The Columbia-Princeton Electronic Music Center was built in the early 1950's in this country. Although the music of Varese, Babbitt, Davidovsky and others of that era is not very popular now, composers of computer music say that within the next ten years the concertgoer will see a new instrument on stage. Only the size of an organ, Professor John Chowning of Stanford says the in-

strument can produce the sound of any orchestral instrument—as well as many sounds no one has ever heard before. It can produce the sound of ten violins, or a sound halfway between a vocal tone and a drum. It can produce sounds that seem to move in space, one minute emanating from some point inside a hall, the next second coming from some place far beyond the hall. If desired, all this at speeds that no human performer could possibly match. An instrument similar to this taking up a mere twelve cubic feet of space has been made at Bell Laboratories in New Jersey. This computer-controlled sound synthesizer can imitate up to 30 musical instruments, produce the sound of from five to twenty instruments playing together, and can play 100 notes per second, with precision. A musician can sit at the keyboard and "conduct" a piece that has been programmed beforehand. By touching the keys and commanding sounds that resemble strings, brass, and percussion, a musician can orchestrate a composition while he plays it.

Robert A. Moog, inventor of the Moog synthesizer, thinks that such systems will never replace conventional instruments. He adds, "It's hard to know what musicians are going to wind up doing fifty years from now." Composer Easley Blackwood has just composed and produced a 45-minute record called "Twelve Microtonal Etudes for Electronic Music Media". Instead of the traditional 12-note system everyone is familiar with, Blackwood explores what music might sound like when the octave has from 13 through 24 equal subdivisions. The record was done on a National Endowment grant and is only available by writing the Chicago composer directly.

No matter what turns music takes in the next fifty years, it promises to be an exciting art to follow. One should feel lucky to be living in such a pivotal moment in music

history. American composer John Corigliano has long and loud said that for the music of the past to survive, there should be a live and vibrant flow of new music. He and others should feel lucky to have such an active part in that history.

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tested has been about ninety-three percent. Calves are believed to be harder to defibrillate than humans.

In all of Dr. Schuder's and Dr. Gold's research, the independent parameter is the current applied. The amount of current required to defibrillate the heart is a function of many things. It depends on the size of the electrodes being used, the geometry and size of the patient, the conducting pastes used between the electrodes and the skin, the resistance of the patient, and any underlying disease which is being treated. The amount of current is controlled through the electrodes of the defibrillator. Two ways exist to obtain the desired current. The first deals with fixing the current, independent of the re-

sistance of the patient and allowing the voltage to change. This technique is impractical. The technique used today is to apply a voltage knowing what the resistance of the subject is in accordance with Ohm's law; V equals RI .

Included in their research, Dr. Schuder and Dr. Gold are working on some special projects. One project deals with developing a device to implant into high risk patients. Electrodes are attached to the heart with wires leading to a miniature defibrillator under the skin. The instrument would automatically defibrillate the heart if fibrillation would occur. This would reduce the chance of damage to the heart and other organs, or even death, due to a time delay in

achieving defibrillation. The problem with this project is in developing a unit small enough, but powerful enough, to implant and effectively defibrillate a fibrillating heart. Also, the materials used present a problem because the heart cannot reject the device if it is to be effective.

Another of the projects, which Wayne McDaniel (an Electrical Engineering graduate student) is also working on, entails making a new unit to attach to an older research defibrillator. This unit will make the previously unidirectional current pulses bidirectional. Dr. Schuder and Dr. Gold hypothesize that bidirectional current may be more effective than unidirectional current in achieving defibrillation. This will be tested on one hundred kilogram calves. The theory is that if bidirectional current is more effective in calves, then bidirectional waveforms should be promising for use in humans.

The new unit is made up of three chassis. One contains a high voltage transformer and rectifier. This will provide up to 7500 volts DC to charge an energy storage capacitor. This is then disconnected and the next chassis comes into play. This chassis is controlled by the timing circuits of the third chassis and is used to discharge the capacitor. The bidirectional current will be administered and defibrillation will be tested.

The goal of such research as Dr. Schuder and Dr. Gold are involved in is to develop a more effective technique in achieving ventricular defibrillation. Without such vital research, no progress would be made. Because of the research it is possible that many lives could be saved or made more productive.

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Ruby Wallis

Conversation

by David Wilkerson

Over \$100,000 was awarded in Scholarship money to engineering students by the Engineering Scholarship Committee. Dr. Gaylord Bunch, chairman of the committee, talks with CONVERSATION about how money is awarded, where it comes from and how a student can apply.

Dr. Gaylord Bunch

CONVERSATION: Dr. Bunch, who is on the Scholarship Committee and what do they do?

DR. BUNCH: The committee is composed of a faculty member from each department, a student from Engineering Student Council, a person from Navy ROTC, Dean Morgan and myself.

They work together to match available scholarship money to the most eligible students. They also represent the students from their respective departments during the discussions.

CONVERSATION: Where does the scholarship money come from?

DR. BUNCH: Many corporations and private individuals make annual contributions. There are also some endowments where the interest money is used.

CONVERSATION: How does a student apply and what are the qualifications that he or she should have?

DR. BUNCH: A student applies by picking up an application from his departmental representative, completing it, and seeing that it is returned by March 1 in order to be considered for the following school year.

There are three things that will be considered for each applicant: academic standing, financial need and professional promise. For most scholarships, academic standing is considered a little heavier than the other two. Most students who receive money have at least 3.25 grade average. However, this is not always the case,

some scholarships require that the award be based on other factors.

CONVERSATION: How does the process of awarding the scholarships actually work?

DR. BUNCH: Each departmental representative will review the applications they receive and consider the three things I previously mentioned to determine who might be most deserving. The committee will then meet in early March and start by awarding scholarships in order of their worth, with the most valuable one being awarded first. Each member will present the case for the one student from his department that he feels is most qualified. Then the committee will discuss each student individually and make a decision by voting. This process is continued until all scholarships are awarded.

CONVERSATION: How effective do you consider this process to be?

DR. BUNCH: I feel that it is very effective. We personally evaluate each student who applies in order to make the best decision we can. We also avoid duplication by trying to limit the number of people who receive more than one engineering scholarship. The committee also gives scholarships to freshmen who graduated in the top ten percent of their high school class. Last year we gave scholarships to about ninety freshmen. So I would say that this program benefits engineering at Mizzou by attracting many talented students.

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much information telephone company managers needed, and how that information could best be reported to them. His responsibilities ranged from software design and systems engineering to field testing of reports and training of CSAR users. With a BS and MS in Electrical Engineering from the University of Illinois, Trevor was prepared for the job.

Here's how CSAR works. Once a week all the Bell telephone companies transmit performance data from their computers to a central computer in Piscataway, N. J. Overnight, CSAR analyzes the information, organizes it for use in many ways, including management reports designed by Trevor, and stores it for retrieval the next day.

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terminals, CSAR users in the telephone companies request a variety of reports: from summaries of switching system performance for an entire company to detailed performance of individual switching systems. The reports can be displayed graphically to summarize performance trends over weeks, months, or longer.

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From Science: Service



Graduating Seniors in Retrospect

by Tom Sapienza

Graduating seniors in the engineering disciplines may be considered the most fortunate of all graduates. Potential well-paying jobs loom over the horizon as engineering seniors near their graduation. Although the job facet is certainly an incentive for the student, the course work can at times be difficult and time consuming.

Many of the students probably reflect upon their experiences here at UMC with as many different thoughts as there are people. This article probes into these seniors' minds and procures feedback obtained from their viewpoints concerning course curriculum, teachers, improvements and vital interests. One student from each of the engineering divisions has been interviewed. Here is what they have to say.

Wesley Steffan Agricultural Engineering

"I found there to be a wide variety of courses offered in agricultural engineering. Some courses were similar to mechanical engineering in the design aspect, while others, especially in the last year of study, were somewhat diversified. The overall design of the courses was generally good. They taught the student the basics and prepared him/her for a capability in design if the student decides so.

"I felt the teachers did a commendable job. Some, though, burdened the student with too much responsibility of learning.

"The addition of more laboratory courses would be beneficial in some areas. There ought to be a reconstruction of some courses, currently offered, and determine whether or not it tailors to the student's needs by means of student feedback. Standardization of course material can be beneficial to a point where it begins to detract from the student's responsiveness.

"I like the course diversity that is offered here. It prepares the student for a wide variety of emphasis areas for him/her to pursue."

Cheryl Cott Chemical Engineering

"I observed that the course curriculum had a strictness concerning choice of the required courses. I feel that there ought to be more laboratory courses offered to fulfill the student's needs than the number currently being offered.

"There are few electives offered and that doesn't allow the student to concentrate on specific areas of interest. This circulates back to the limit of appropriate courses. Some particular courses may contain too much theoretical material and not enough hands-on-training.

"A lower teacher to student ratio would be more beneficial to the students."

John Shouse Electrical Engineering

"I felt the design of the course curriculum was good, except it could have been better in the underclassmen courses. Sometimes problems existed in specific courses in that they became too redundant, especially when the concepts presented became boring to the student. I believe that there should be a non-standardization of course curriculum and teachers should be able to teach different material for the same course.

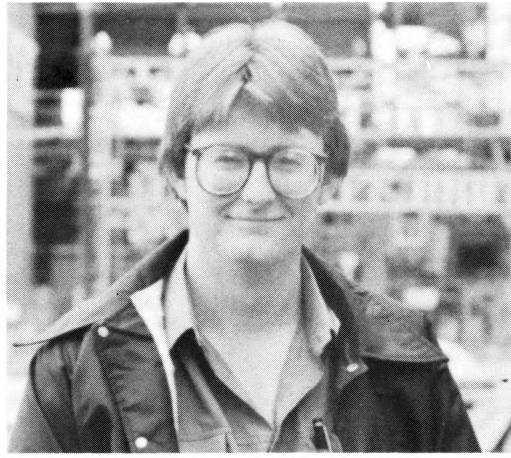
"The teachers were most effective in the upper division courses while least effective in the lower division courses. Some teachers need to stimulate students better in the classrooms and studies and try to establish a better rapport with them.

"I like the broad base of course curriculum in the beginning of the student's education, and the branching out to specific areas later. This background develops good self confidence building."

(Not Pictured are David Wilkerson and Cheryl Cott.)

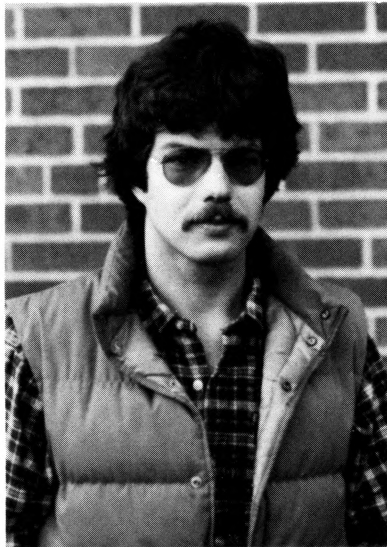


Julie Blair

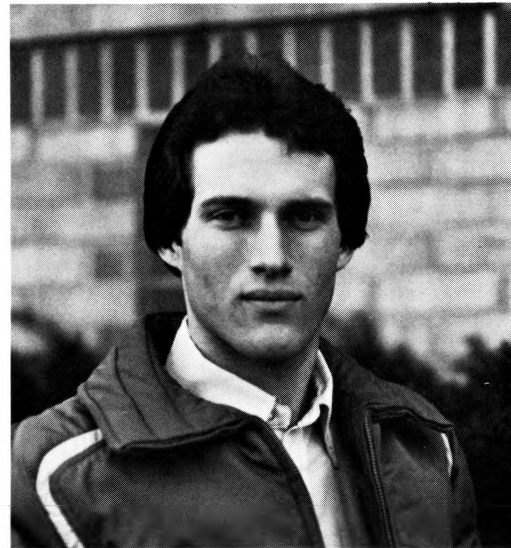


photos by Ruby Walla

John Shouse



Ed. King



Wesley Steffan

Julie Blair Civil Engineering

"I found the course curriculum provided a very good foundation for the student and prepared him/her for possible job projects. The course requirements were well developed in concept. Since the department's electives need to be approved by an advisor, I feel this is important for the student to gain the fullest amount of benefits from his/her education.

"I would like to see a course offered in estimating and contracting as an elective. The course curriculum ought to cover courses which are more practical—those geared to actual field experience. It would be better for the student if a minimum of course material were taught for required courses except that teachers ought to be able to present it in their own manner.

"I find that the design approach of the courses is excellent."

Dave Wilkerson Industrial Engineering

"I was generally pleased with the department's course curriculum because it was very flexible. It also allowed the student to make it what he/she wanted it to be and provided a broad overview of courses for a well-rounded education.

"There exists some confusion among students concerning the proper sequence of required courses, but the department recognizes this problem and attempts to correct it.

"The department faces a shortage of faculty. Many a teacher have a good understanding of industry and this prepares students well for possible job prospects.

"Again, the courses provide a good, broad exposure for the student. It is the variety that I especially like."

Ed King Mechanical Engineering

"The required course curriculum gave the student adequate background, while electives provided instructional assistance. I felt there were no unnecessary required courses.

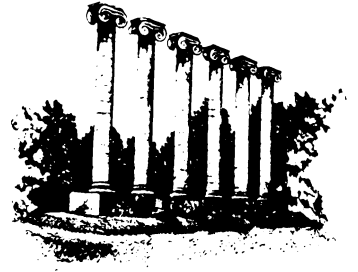
"I found it beneficial for the student to become familiar with computers. Computer courses should be offered early in the student's education to promote interest and knowledge toward their applications.

"A standardization of courses would be good, in that an effort be made to cover the same material by all professors. Any extra material covered should be observed by a statement from the course syllabus.

"I found the electives to be very beneficial. They helped pave the way for proper job preparation."

West of the Columns

by Michelle Morris



In the electrical engineering lounge, in a tiny little room, exists a complete snack bar managed by Marie Crump. Amazingly, Marie serves a menu almost as diverse as the Union or Brady, but from a room that measures hardly 5'x12'.

Isolated from the rest of the University, Marie practically runs her own business. She monitors changes in food demand and orders accordingly. The Union delivers these orders daily, usually around 11:00. Most important to making business run smoothly, is organization. Once the food arrives, everything must be filed into its own unique space. Cramped quarters make this a necessity. A refrigerator, sink and soda fountain take up a majority of the room, yet Marie is hoping to get an even bigger refrigerator for her growing inventory.

Recently, the E.E. snack bar acquired one of the two microwaves the University owns. This has enabled Marie to expand her menu. Bagels and cream cheese, burgers and hot ham and cheese are just a few favorites. Marie notes that the microwave has inspired students to bring more imaginative lunches from home: lasagna, for instance.

A new microwave is not the lounge's only addition. A new sign, listing the menu and prices, has been firmly bolted in place. Two previous signs have mysteriously walked off. Not only does the sign occasionally disappear, but the magnetic letters have a perplexing way of rearranging themselves. The 's' in "extra crackers" is a favorite maneuver. Marie laughs at this and it is obvious she enjoys her work regardless of pranksters.

After working twelve years at the Bengal Lair, Marie has been with the E.E. snack bar since its inception two years ago. She hardly misses a day of work. "I just don't believe in that." From a farm outside of Ashland, she arrives at work by 7:30, greeting her customers cheerfully. In fact, she knows her regulars by name. And after every purchase, you can be assured Marie will pass on her favorite phrase: "You have a nice day now."

Marie Crump

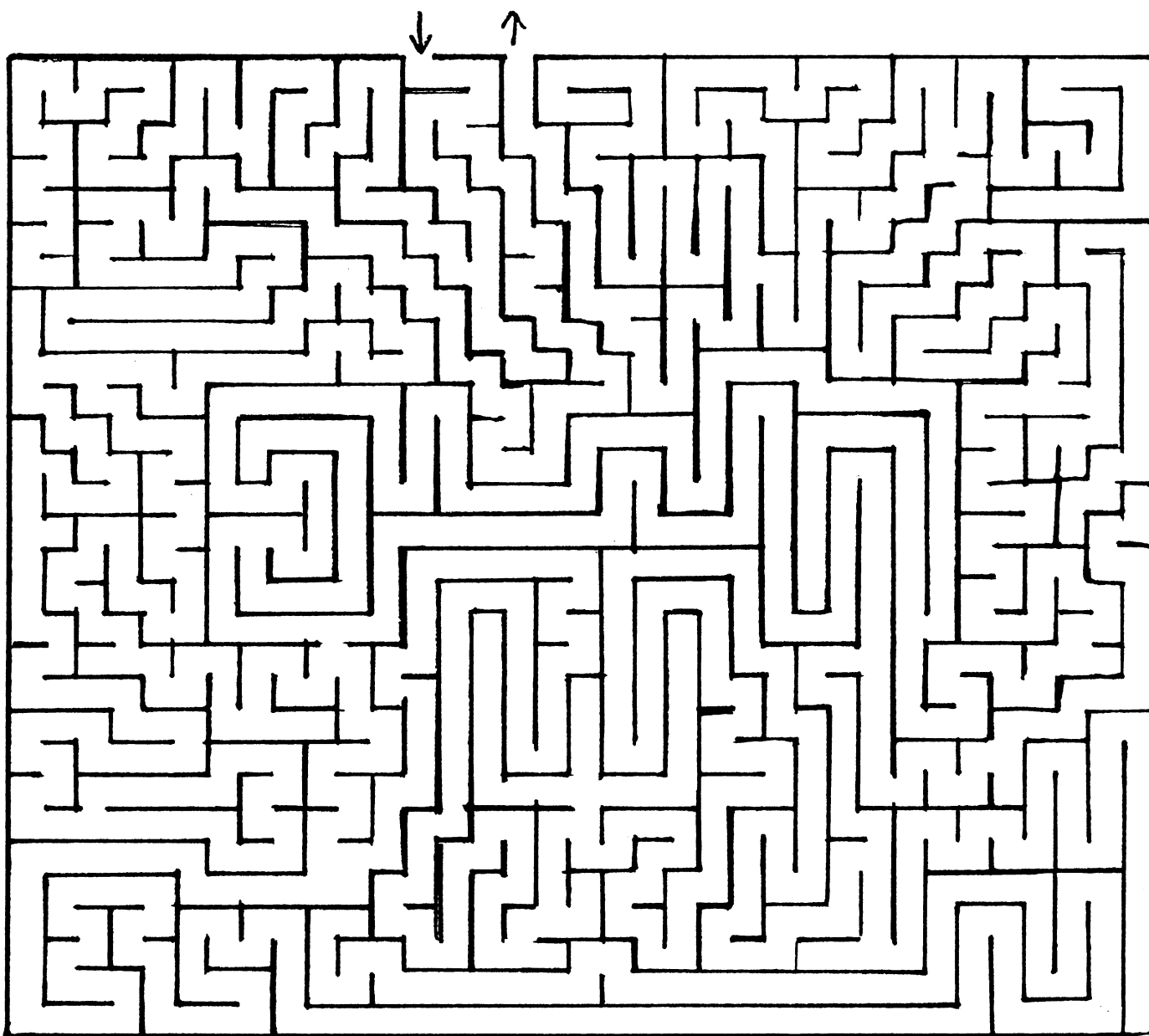


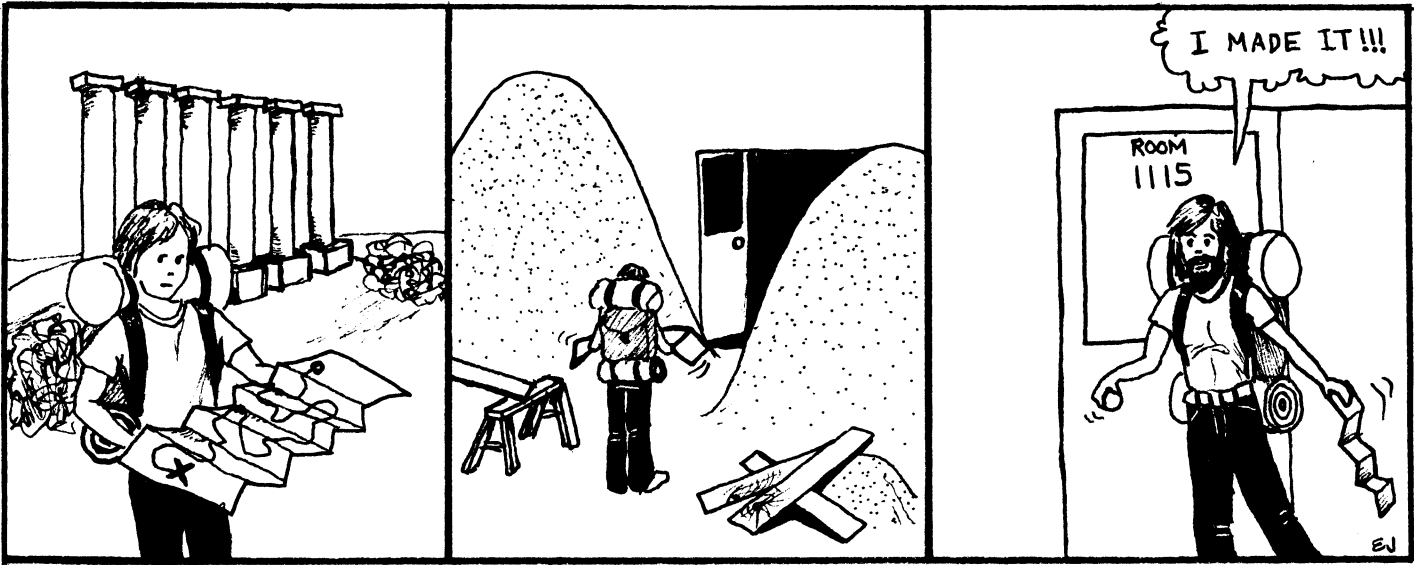
Ruby Walia

Thought Gallery

by Jean Babcock

(Ed. Note: Special Thanks to Jean Babcock for her Maze. Jean graduated with an Industrial Engineering degree last December)





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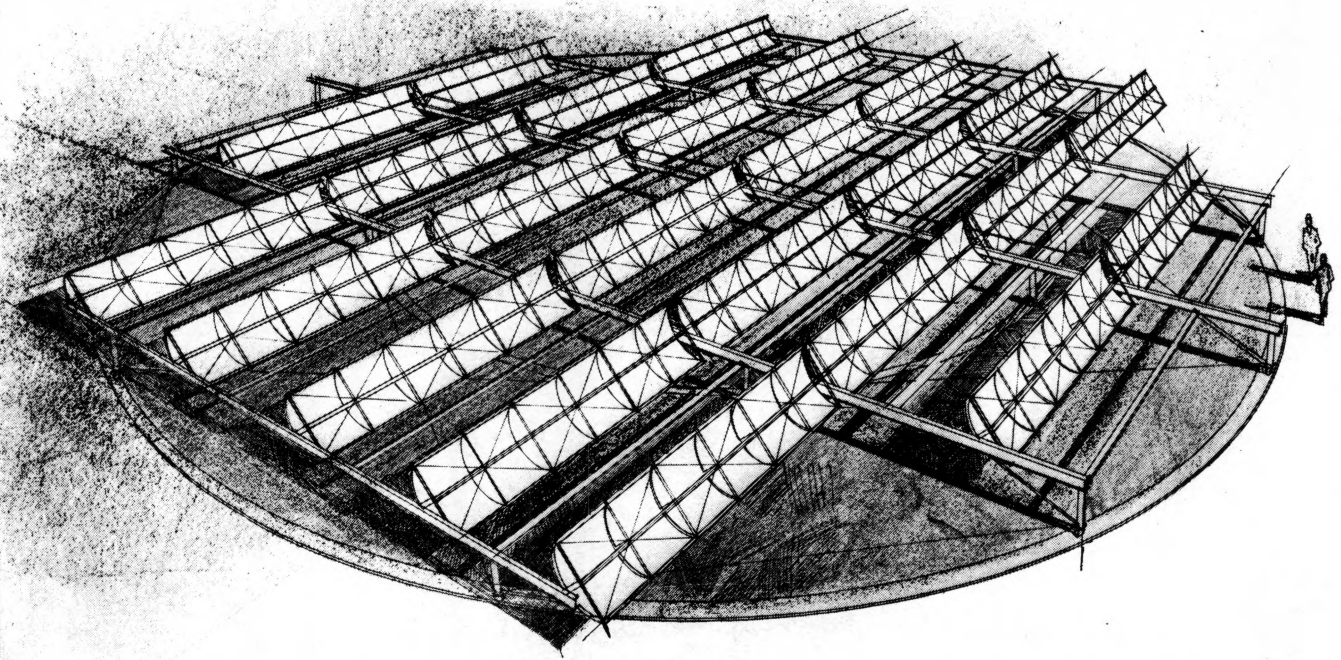
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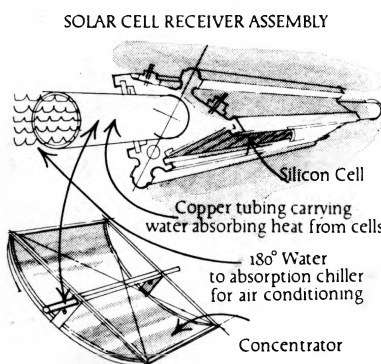




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