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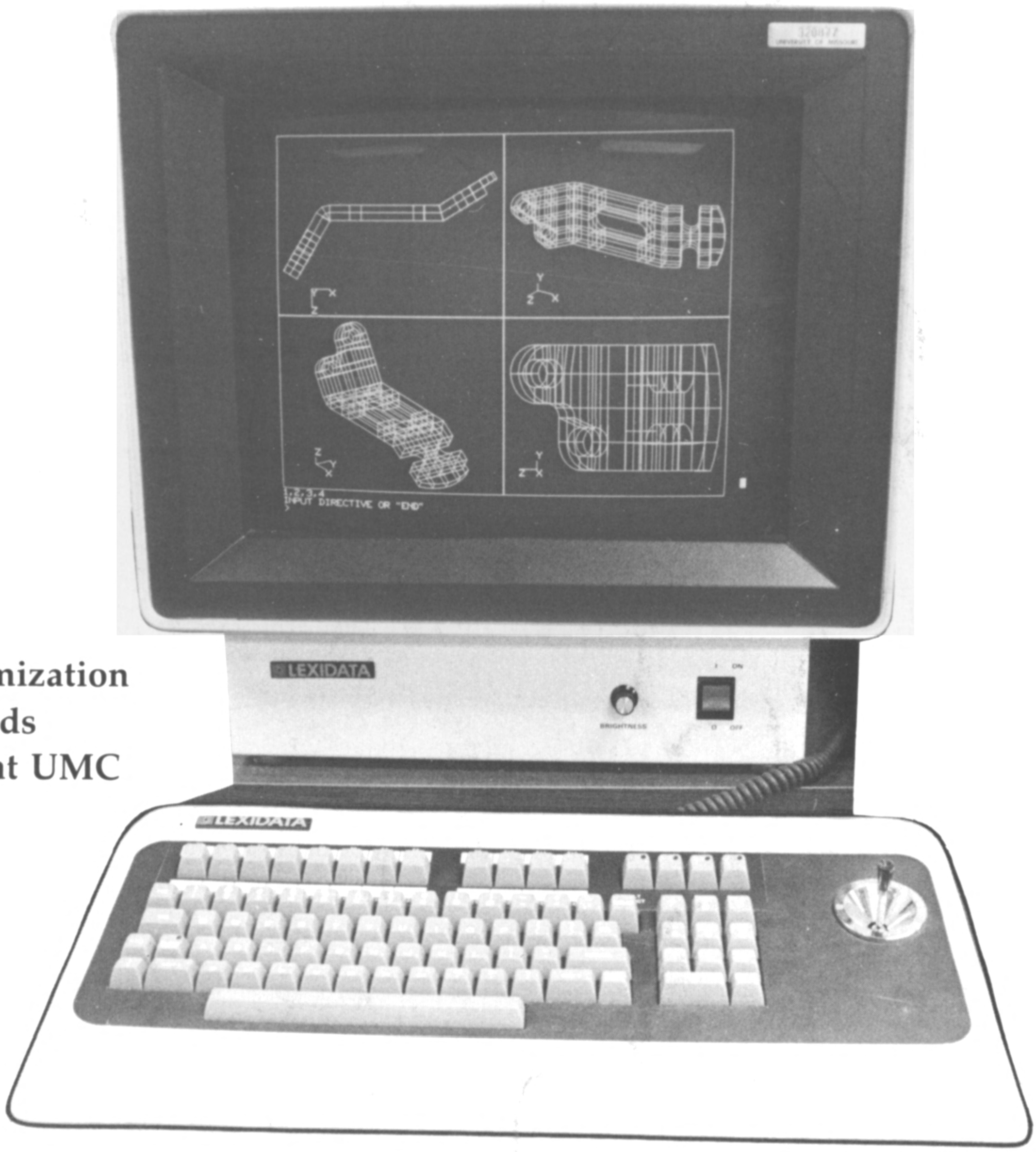
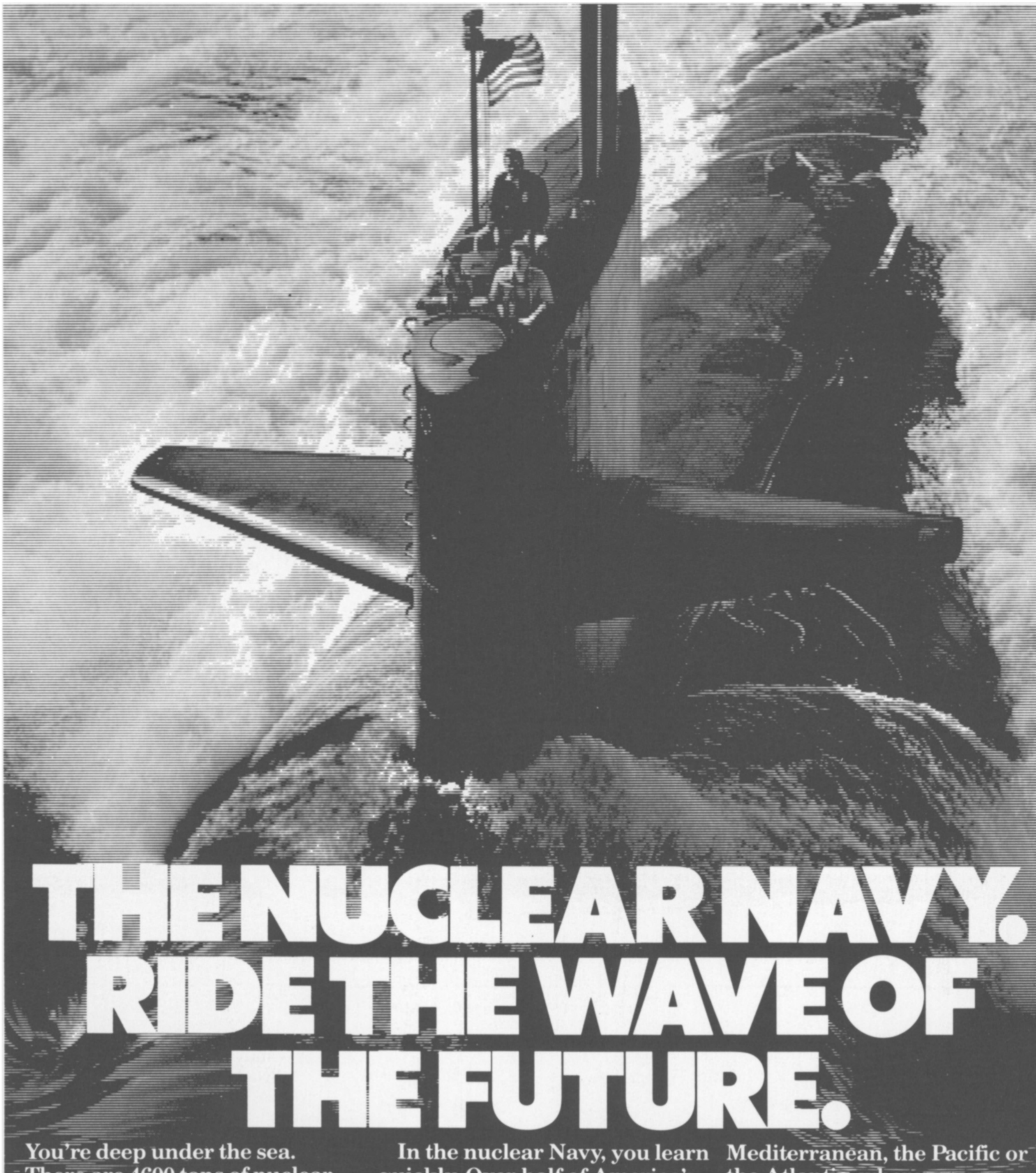


Design Optimization Lab Finds New Home at UMC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Missouri
SHAMROCK

The UMC College of Engineering Magazine

Nov./Dec. 1984 Vol. 78 No.1

contents

The Missouri Shamrock is published three times annually (Nov/Dec, Feb/March, April/May) by the engineering students of the UMC College of Engineering. Opinions stated herein do not necessarily reflect the views of the College of Engineering.

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Foremost, the Missouri Shamrock acknowledges its advisors, Robert W. Leavene, Jr., Assistant Professor of Electrical and Computer Engineering, and Annette Sanders, Director of Engineering Communications, UMC College of Engineering.

Editorial: A Wilting Shamrock Revived!

Back row from left: Rick Winegar, Mark DeYoung, Melodie Rooker, Annette Sanders, Cindy Bohr, Linda Roehrs, Jim Kernell. Front row from left: Keith Mueller, Janice Ehrhart, Mourad Chihaoui, Jim Berquist, Robert Leavene, Brian Gustin, Angelo Keene. Not pictured: Layli Alexander, David McDowell, Bruce Hamby, Jon Coker.

It is my great pleasure to introduce to you this new and exciting first publication of the 84/85 academic year. The **Missouri Shamrock** has been nurtured back to health and we have gone so far as to plan for the future. This first issue has been in the development stage since late summer and with the help of a most dedicated staff we have been initiated into journalism. The following is a brief history of the **Missouri Shamrock** from the beginning as it has been reported in previous publications.

From 1906 to 1933 the engineering students at UMC published annually in March a pamphlet known as **The Shamrock.** The issues from 1906 to 1911 were similar in format and were devoted to the St. Pat celebration. These issues were printed in green ink and contained several poems devoted to St. Pat. The 1912 issue was of slightly different style but was still devoted to the St. Pat's doings.

The beginnings of a change in the nature of **The Shamrock** appeared in the 1913 issue. The **Shamrock,** from these years onward, devoted fewer pages to the St. Pat's celebration and more to the school of engineering. In 1916 the publication again changed format and became more of a yearbook of the school of engineering and included pictures of the graduating engineers, the undergraduates, the accomplishments of the school and students and a summary of Engineer's Week. At this point the doings of St. Pat were reduced to a minor part of the publication.

From 1916 to 1933 the annual publication of **The Shamrock** kept the same format. In the fall of 1933 the name "Shamrock" was appropriated by a new magazine published by the students of the College of Engineering, and no more of the annual pamphlets bearing this title appeared. The new magazine was in no sense a continuation of the old **Shamrock,** but was actually a continuation of a magazine established in 1931 under the title **The Engineers Monthly Bulletin.**

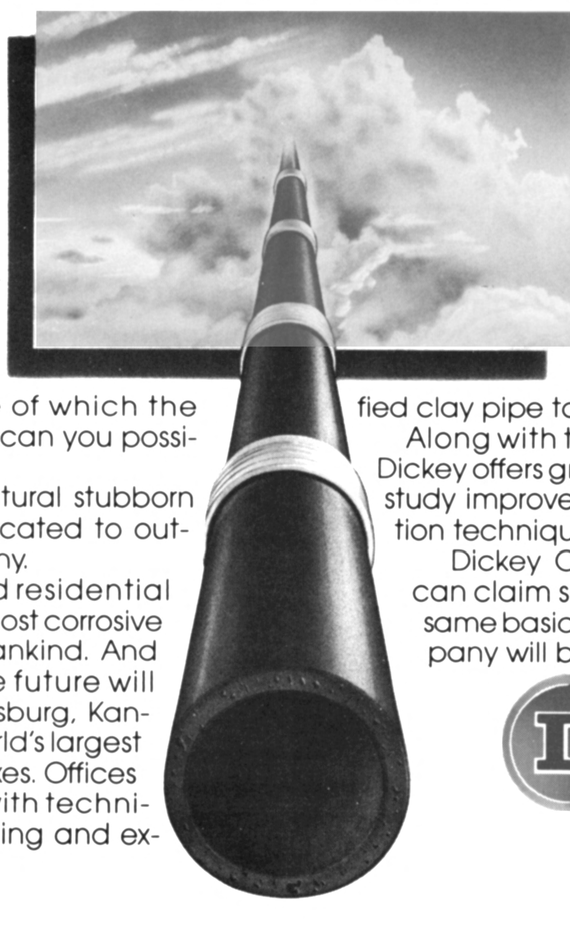
The **Shamrock** was then published monthly under the new format. In 1937 the title of **The Shamrock** was changed to **Missouri Shamrock,** then in 1941 the title was again changed to **The Missouri Shamrock.** Finally the last change took place in the 1970's. The **Missouri Shamrock** went from a monthly publication to a quarterly publication. We will follow a three-times-a-year schedule.

You can look forward to the next issue of the **Missouri Shamrock** at the end of February. It will contain an exciting review of Engineer's Week 1984, a preview of the upcoming Engineer's Week, and many other articles of interest to engineering students and faculty.

I am looking forward to an exciting year as editor, and I hope that you will follow us and the **Missouri Shamrock** through another successful school year.

Jim Kernell

Jim Kernell, Editor
Missouri Shamrock



New Chairman Brings Lab With Him

by Mark DeYoung

Dr. Kenneth M. Ragsdell, University of Missouri's new chairman of mechanical and aerospace engineering (MAE) and Croft Professor of Engineering came to UMC four months ago and brought with him over 21 years of personal engineering experience, four graduate students from the University of Arizona, and his "baby."

The Design Optimization Laboratory is a project that Ragsdell developed from the initial idea to its current status. It serves as an information source to world industries and universities who fund the lab at over $325,000 per year. Because of the significant role he has played in its development, Ragsdell often refers to the lab as his "baby" or "child."

"One of the reasons I left the University of Arizona was Missouri (UMC) offered me the opportunity to be department chairman as well as director of the Design Optimization Laboratory," he said. "I had the opportunity to take on management responsibilities as well as direct the lab.

"I guess you could say I'm the father of the laboratory, but I'm not *the* laboratory," he said. "Work is done by many others."

Among the laboratory workers are assistant professor of MAE and associate director of the laboratory Eric Sandgren. Also carrying a large work load are four graduate students who worked with Ragsdell in the lab at Arizona. They decided the project was so worthwhile that they are now University of Missouri graduate students. Acting as manager of the lab is graduate student Mark Iannuzzi. He explained the significance of Ragsdell's work: "Dr. Ragsdell is pretty much world famous for design optimization," Iannuzzi said. He continues, "The lab—which uses software to communicate optimization of basic and applied knowledge—produces information that is received by various universities and companies all over the world."

The purpose of the laboratory itself is twofold—to provide a quality education to properly prepared and motivated graduate students, and to address the current and future American industrial need for effective and automated methodology. Ragsdell emphasizes that optimization is a means for gaining a better understanding of design and development. "You have to understand that while design is the essence of engineering, optimiza-

Professor Kenneth M. Ragsdell talks about the Design Optimization Laboratory.

tion is the essence of design," he said.

Ragsdell's pioneering in optimization is no secret. He is author or co-author of over 70 technical publications, co-author of the recent Wiley book, **Engineering Optimization,** co-editor of **New Directions In Optimum Structural Design,** another Wiley book released this year, as well as numerous research reports. Ragsdell went on to describe the laboratory's purpose in yet another way.

"The basic mission of the laboratory is to discover effective communication of basic or fundamental knowledge in the areas of computer-aided design and manufacturing technology, with an emphasis upon quality and competitive position in American industry."

Many of the ideas behind the laboratory were conceived while Ragsdell was earning his PhD at the University of Texas from 1968-72. Upon receiving his doctorate in 1972, Ragsdell served as assistant professor of mechanical engineering at Purdue University for 10 years. While at Purdue, the concept of the laboratory itself was developed, and put into its initial stages. It was there Ragsdell first met Sandgren.

"Eric Sandgren was my first graduate student at Purdue and unquestionably the brightest graduate student I've had," he said, "he was with me all along at Purdue."

As the laboratory progressed through its infant stage at Purdue, Ragsdell was invited by the University of Arizona to continue his work and expand the laboratory. In 1982, Ragsdell and the optimization lab accepted the invitation and moved to Arizona. It was there that the Design Optimization Laboratory received its official name and began receiving national recognition.

"The laboratory," he said, "is now funded by many companies by invitation only. The relevance of the lab is easily seen when you have Xerox, IBM, Whirlpool, GM . . . and more, supporting your efforts."

Currently, there are five companies supporting the project in an excess of $25,000 per year, with IBM giving as much as $60,000 per year. There are a number of other companies and universities that contribute smaller sums.

"I'd have to say that the one thing I am most proud of is the support we've enjoyed from major industry, of the laboratory concept," Ragsdell commented. "The concept is different, and I'm delighted industry is supportive."

Ragsdell and Iannuzzi both agree that the optimization lab helps bridge the gap between higher education and industry.

Ragsdell explains, "The normal products of a university are first, students, and second, knowledge through research. Implementing bright ideas developed in a university, however, takes much too long to be of practical use to private industry. Therefore, industry and university researching are usually two separate worlds."

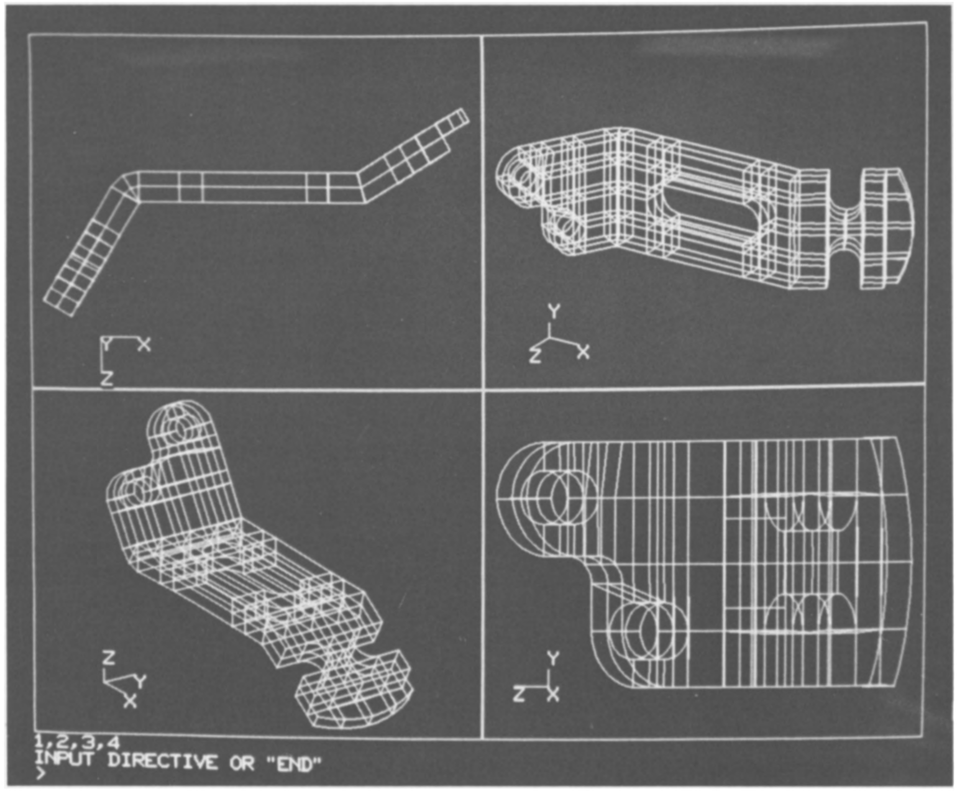
Ragsdell has witnessed that this doesn't have to be the case. "We distribute our research results in the form of software to what we call our 'Software Users Group,' " he said. "Our research laboratory has a very close relationship with industry."

The Design Optimization Laboratory is now located in the Engineering Complex on Mizzou's campus. However, it has not quite reached the efficiency level it once had when it left Arizona.

"We are still getting things together here," Iannuzzi said as he looked around his office in the lab. "By the first of the year we will be back to full speed."

Although Dr. Ragsdell has great pride in the lab, he is also facing the challenges as MAE department chairman. His managerial responsibilities range from student, faculty and curriculum matters at UMC to similar matters in Kansas City where he is also department chairman of six faculty positions in the Cooperative Undergraduate Engineering Program (CUEP).

"Some typical issues I will be dealing with are health and quality of the program, enhancement of the pro-



This screen in the Design Optimization Laboratory shows how the computer produces a three-dimensional representation of an object.

The Equilibrium Solution

Rapid, reliable methods for solving chemical equilibrium equations have long been sought by scientists asking fundamental questions about systems as varied as the atmosphere, the human body, and the internal combustion engine. An interdisciplinary collaboration at the General Motors Research Laboratories has produced a breakthrough with potentially universal applications.

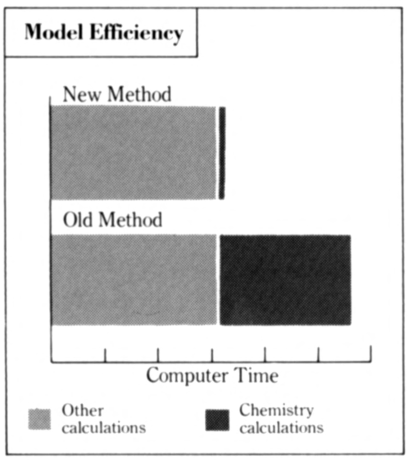
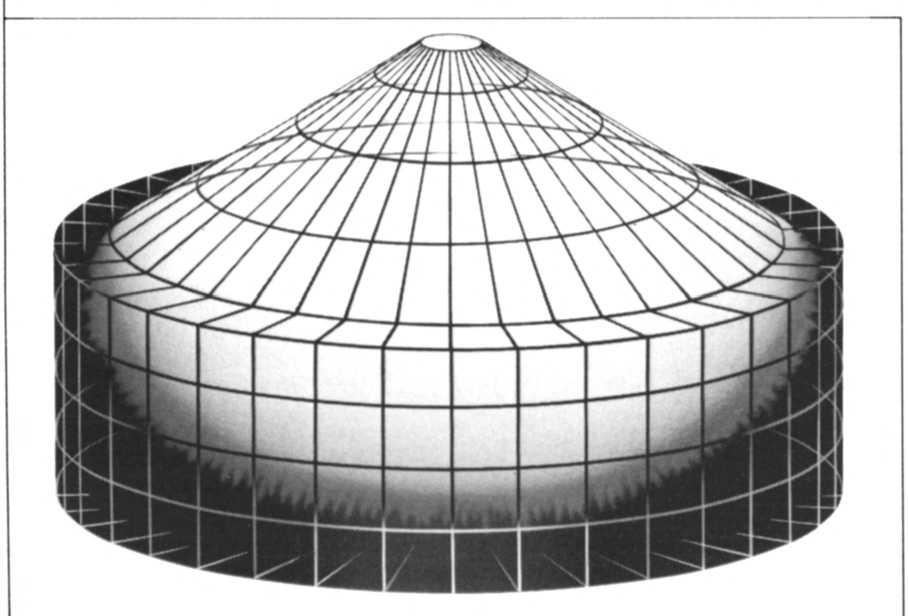


Figure 1: Computer time required by an engine combustion model. Time required for chemical calculations decreased greatly with the new methodology.

Figure 2: Artist's illustration of a chemically reacting flow. The physical space is divided by a latticed network into units of volume, and the solution must be recalculated for each grid point at each instant of time.



WHEREVER CHEMISTRY is involved, the need to solve chemical equilibrium equations arises. Although methods for solving such equations have existed for some time, they do not offer the speed demanded by the most challenging problems. For example, predicting the composition of gases inside an engine cylinder may require as many as a million equilibrium calculations per cycle. Two researchers at the General Motors Research Laboratories have developed a systematic way to reduce the mathematical complexity in these problems, thus making it possible to solve them rapidly.

Chemical equilibrium occurs when the rates of a forward and reverse reaction are equal. Mathematically, this statement usually translates into a system of nonlinear polynominal equations. Until now, there has been no fast reliable method for solving such systems. Solutions to particular problems have demanded thorough familiarity with the physical conditions. In most cases, this means partial knowledge of the answer.

Dr. Keith Meintjes of the Fluid Mechanics Department and Dr. Alexander Morgan of the Mathematics Department began their research by considering recent advances in the theory of continuation methods. They concluded that a suitable continuation algorithm could be relied on to solve the nonlinear polynomial equations that make up chemical equilibrium systems. In this insight lies the realization that the solution can be obtained without any knowledge of the physical nature of the problem.

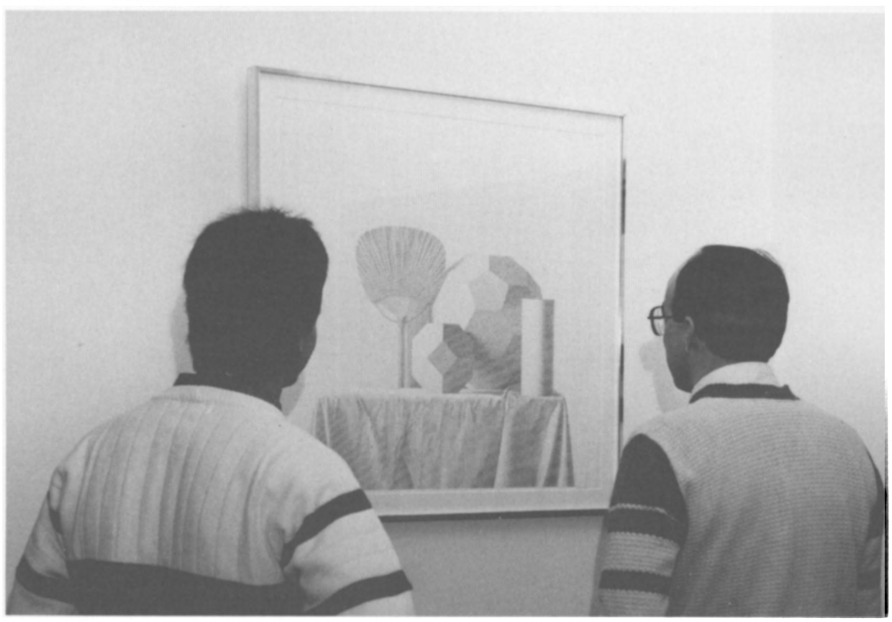
In seeking the most efficient implementation of the continuation method, the researchers discovered that chemical equilibrium equations can always be systematically reduced to a substantially simpler mathematical form. The reduced systems have fewer unknowns and a smaller total degree. The total degree of any system is the product of the degrees of each of its equations. Reducing the total degree makes a system easier to solve. A typical combustion problem with ten equations and total degree of 192 was reduced by the researchers to two cubic equations with a total degree of nine.

The reduced systems can then be systematically scaled to fit within the limits imposed by computer

College Receives National Recognition

by Janis Ehrhardt

The University of Missouri College of Engineering was the recipient of the 1984 Koerper Award. This award recognizes schools of engineering that provide noteworthy programs to instill professionalism in engineering students and that aid in communicating the need for professionalism. The award, presented by the National Society of Professional Engineers (NSPE), consists of a plaque and a $1000 stipend to acquire an appropriate work of art for display in the college. The annual honor is made possible by a grant from the late Erhardt C. Koerper, P.E., a designer, inventor, and industrialist who was active in both the engineering profession and the arts. With hopes of expanding students' aesthetic awareness, Koerper designated art as the medium for the award. The College of Engineering purchased a painting which is hanging in the Engineering Dean's office at 1010 Engineering.



Artwork purchased with the Koerper Award stipend hangs in the dean's office in the Engineering Complex.

Dean William R. Kimel received the award on behalf of the college at the January 1984, meeting of NSPE. He congratulates UMC students and faculty for earning the national recognition for professional development. "I would emphasize that our students themselves initiate and carry on many of the activities cited in the Koerper Award nomination, while faculty members set the general tone, serve as role models, and offer needed support and continuity of purpose," Kimel said. "The artwork to be displayed as a result of this award will serve as a permanent reminder of the need for a spirit of professionalism in the education of succeeding classes of UMC engineers."

Engineering Extension: Meeting the Asbestos Problem Head-On

by Linda Roehrs

It began as a seemingly harmless and practical use of a naturally occurring mineral. Because it does not burn and is a very poor conductor of heat and electricity, asbestos was once considered an excellent form of insulation. During the construction that followed World War II, asbestos was used widely and without precaution. Now exposure to asbestos is considered the most serious occupational health hazard in both the United States and Great Britain. In addition, it is estimated that asbestos-related disease will kill one American every fifty minutes for the remainder of this century.

Asbestos course instructor demonstrates techniques of removing the substance from buildings.

Public concern over health risks related to asbestos has increased sharply during the last few decades. In the 1940's and 50's asbestos was used frequently in a variety of applications. It was often sprayed on ceilings, pipes and steel structures for purposes of insulating, fire proofing and soundproofing. Eventually inhalation of asbestos fibers was linked to lung cancer and asbestosis, a thickening of the lung tissue. It is minimally fifteen years before asbestosis appears after the fibers have settled in the lungs; this is the reason that fatalities and disease due to asbestos exposure continue to occur even after its use is sharply curtailed and clean-up programs implemented.

As asbestos that was used in construction begins to deteriorate, hazardous fibers are released into the air. Asbestos fibers are extremely small, easily inhaled into the respiratory system, and impossible to remove once they are inside the body where they irritate and damage lungs. Special precautions must be taken during the removal of asbestos since the fiber concentration can get very high.

UMC is doing its part to aid in the nationwide attempt to rid buildings of asbestos. The College of Engineering Extension Program conducts a ten-hour seminar titled "Safe Removal of Asbestos from Buildings." It covers informational topics such as federal regulations governing asbestos removal, as well as practical instruction for the actual removal procedures. The course is aimed at architects who are responsible for renovation of buildings, persons who will supervise asbestos removal projects, building administrators, and health officials.

The extension course has been well attended. Some sessions have had requests for registration beyond the thirty openings for each session. Over 600 participants have attended the workshop since it was first administered in December of 1982. Three sessions were conducted this fall and three more are scheduled for the spring of 1985. In addition to teaching sessions in St. Louis, Kansas City, Columbia, and Rolla, instructors have traveled to Phoenix, Arizona and to Lincoln and Omaha, Nebraska to give the course. As public awareness of the asbestos hazard increases and enforcement of asbestos-related regulations becomes more stringent, continued interest and participation in the workshop is expected.

arithmetic. The range of coefficients in chemical equilibrium systems tends to be too large or too small for the arithmetic of the computer. Consequently, the solution process can fail. By construction of an effective scaling algorithm, this arithmetic constraint can be eliminated. Suitably reduced and scaled, the equilibrium systems can then be solved reliably by the continuation method.

THUS, Drs. Meintjes and Morgan accomplished their original goal of developing an innovative reliable approach to solving chemical equilibrium equations. They also made a final, unexpected discovery. Certain standard solution techniques, which fail on the original systems, can be made absolutely reliable when applied to the reduced and scaled systems. These methods, which are variants of Newton's method, are also many times faster than continuation.

This research has produced an extremely effective solution strategy—reduction of the equations, followed by scaling of the reduced systems, followed by the application of a suitable variant of Newton's method. The simplification of the systems, which was originally formulated to facilitate the implementation of the continuation method, proved to be the critical factor enabling the use of fast techniques.

In one application, the chemical equilibrium calculations are part of a model which predicts details of the flow, turbulence, and combustion processes inside an engine. By using their methodology to develop an equilibrium solver for this application, the researchers greatly increased the model's solution efficiency (see Figure 1).

"It was the characteristic structure of equilibrium equations," says Dr. Meintjes, "that allowed us to perform the reduction. The unexpected mathematical simplicity of the reduced systems suggests that even more efficient solution methods may be discovered."

"Critical to this research," says Dr. Morgan, "was the dialogue between disciplines. I hope that this dialogue will continue as scientists and engineers in diverse fields explore the capabilities of this new methodology."

THE MEN BEHIND THE WORK

Dr. Keith Meintjes, a Staff Research Engineer in the Fluid Mechanics Department, joined the General Motors Research Laboratories in 1980. Dr. Alexander Morgan, a Staff Research Scientist in the Mathematics Department, joined the Corporation in 1978.

Dr. Meintjes (left) was born in South Africa. He attended the University of Witwatersand, where he received a B.Sc. and M.Sc. From 1973 to 1975, he taught fluid mechanics and engineering design at the university. He then went on to study at Princeton University, where he received an M.A. and Ph.D. in engineering. His doctoral thesis concerned numerical methods for calculating compressible gas flow.

Dr. Morgan (right) received his graduate degrees from Yale University in differential topology. His Ph.D. thesis concerned the geometry of differential manifolds. Prior to joining General Motors, he taught mathematics at the University of Miami. His book, "Applications of the Continuation Method to Scientific and Engineering Problems," will soon be published by Prentice-Hall.

gram and growth of the program. I'm concerned about the quality," he said (and still keeping the idea of optimization in his head went on to say) "I want to see to it that we get the best performance with the resources we have."

Ragsdell also has a fondness for teaching. While receiving his Bachelor of Science and Master of Science at the University of Missouri-Rolla, he got his first taste of teaching.

"My first teaching assignment was when I was a junior at Rolla," he reflects. "I taught engineering graphics and really enjoyed it. . . . I love interaction with the students; it keeps me younger."

Ragsdell is currently teaching two courses at Mizzou: "Digital Computer Applications in Engineering" (MAE 304) and "Software Engineering" (MAE 300).

Amid his teaching, his administrative responsibilities and the Optimization Laboratory, Ragsdell admits there is not much free time and said that when he does manage to have free time he likes to spend it with his family.

"I'm happy as a lark and always busy," he said.

Looking into the future, Ragsdell's most recent project which is also greatly supported by the University is the establishment of a Design Productivity Center at UMC. Its purpose is to encourage the creation and communication of fundamental and applied knowledge in the areas of management, engineering, and manufacturing technology which have an impact on American industrial productivity.

"There is an urgency in the United States to improve our manufacturing capabilities," he said. "Our standard of living is in jeopardy if we let our manufacturing industry continue to fall behind."

Ragsdell became more aware of this urgency in the summer of 1984 when he went to Japan to study the difference between American and Japanese industry.

"Japan and Germany are beating us with our own technology," he said. "In the United States today, it is not possible for us to initiate a conceptualization that is a clean sheet design and market a product, because the time it takes from the initial conceptualization to the finished product is significantly longer in the U.S. than in Japan."

Assistant Professor Eric Sandgren instructs a student on computer-aided design.

The major obstacle to the Design Productivity proposal is funding. In response to the obstacle, the College of Engineering at UMC has submitted a proposal to the National Science Foundation for more than $7 million over a five-year period.

He feels that the Design Optimization Lab is a step in the right direction and that a Design Productivity Center is a great step in the same direction.

"That's what we're interested in. We want to see companies in the United States be able to take a new idea for a product, turn it into a quality product and then introduce it into the market place in the shortest possible time with the highest received quality measure," he said. "We currently can't do that.

"I'm very interested in the proposal to the National Science Foundation," he said. "We want to make sure that innovation is a certainty in the United States and thereby enhance productivity."

The University should receive indication by January, 1985, as to whether the funding shall be granted. Nevertheless, Ragsdell has made it his personal mission to see to it that something is done for American productivity, and in fact, this is the long range goal of Dr. Ragsdell's "baby"—to have a positive impact on American industrial productivity.

"When I retire, I'd like people to say Ken Ragsdell did his part to revitalize American industry and along the way educated some top flight engineers . . . but I don't plan on retiring for at least 800 years."

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A great place for engineers

IEEE's Centennial Celebration: the second century begins

by Angelo Keene

The UMC student branch of IEEE recognized a milestone in the history of the national organization by participating in the first national video teleconference to be downlinked to the University campus. The event celebrated an important historical plateau that was reached after 100 years.

On May 13th, 1884, during the International Electrical Exhibition, the American Institute of Electrical Engineers (AIEE) was established. This particular International Electrical Exhibition was organized by the Franklin Institute of Philadelphia to show the usefulness of the relatively new concept of harnessing electrical energy. Several notable inventors of the period were present, such as Thomas Edison, Edward Weston, and Elihu Thomson. During the last week of the Exhibition, the first official technical meeting of the AIEE was held.

However, in the one hundred years since that initial convocation, the AIEE has not remained the organization that it once was.

It's gotten better.

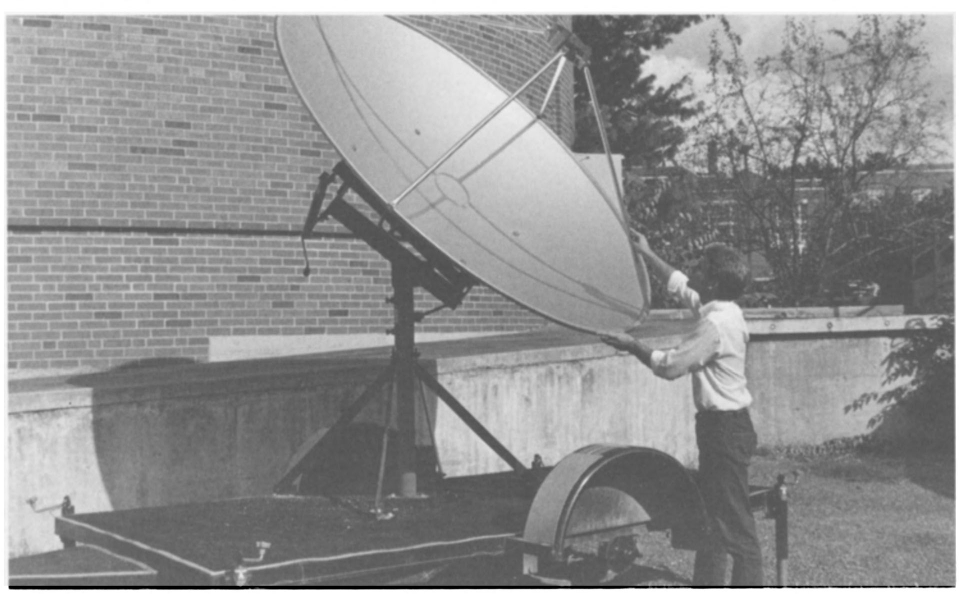
This year, from October 7th to the 9th, the IEEE (The Institute of Electrical and Electronic Engineers—the successor of the AIEE) commemorated the centennial of that first technical meeting of the AIEE with a special technical convocation/celebration: "The Second Century Begins."

A panel discussion was aired live via satellite from the Franklin Institute in Philadelphia. The keynote speaker was Bernard M. Oliver, recently retired Board Member and Vice-President for Research and Development at Hewlett Packard. The panelists were: Charles H. Townes, Professor of Physics at the University of California, Berkeley; Alvin Toffler, scholar and author of books such as **Future Shock** and **The Third Wave;** Joshua Lederberg, President of Rockefeller University, New York, and recipient of the 1958 Nobel Prize in Medicine for research in genetics was the closing speaker. Moderating the discussion was Edward E. David, Jr., President of Exxon Research and Engineering Company, former Science Advisor to the President and Director of the White House Office of Science and Technology. The speakers discussed technology's growth and possible future.

The convocation was received in Columbia, and aired in the Electrical Engineering Auditorium, thanks to concerted efforts by (to name a few): Jonathan Coker, vice-chairman of UMC's student branch of the IEEE; Dr. Robert Leavene, faculty advisor to IEEE; Dr. Cy Harbourt, technical advisor; and David McDowell, a student member who donated the use of the satellite dish used to receive the broadcast. The broadcast was televised at 7:30 p.m. on October the 9th.

Also present was a local panel consisting of UMC faculty members who were invited for a question and answer period that followed the convocation. The local UMC faculty panelists were: Dr. Russell Pimmel, professor of electrical and computer engineering and co-author of **Microcomputer Based Digital Systems** (McGraw Hill); Dr. Margaret A. Flynn, professor in the Department of Family and Community Medicine, member of the Board of Editors-"Journal of American Dietetic Association", and chairperson of the Research Committee for American Association of Clinical Nutritionists; Dr. Clifford Tompson, professor of physics, director of undergraduate studies in physics, and a research associate at the University of Missouri Research Reactor; and Dr. John W. Yarbro, professor of medicine and editor of "Seminars in Oncology".

There were 75-100 people in attendance at the beginning of the convocation. However, when it ended two



Jonathan Coker adjusts the satellite dish for the IEEE centennial celebration.

Panelists Dr. Clifford Thompson, left, Dr. John W. Yarbro, center, and Dr. Margaret A. Flynn await the question and answer period.

hours later and the panel discussion began, a smaller group remained. But this didn't deter the panelists. The topics discussed after the convocation ranged from the impact of technology on society to how entering students might be better educated. This discussion period lasted about one hour after the end of the broadcast.

The UMC College of Engineering's student branch of the IEEE is entered in a competition with other student branches that viewed the broadcast as well. The competition is basically a review of each branch's originality and amount of work done to promote the event. The results and announcement of the winner will be later in the year. As of now, there are no immediate plans to repeat the satellite linkup soon, but if another opportunity presents itself with the potential importance that this first teleconference at UMC has had, then the option is open.

Funds, the Foundation of It All

by Melodie Rooker

As a result of inadequate engineering student facilities and faculty salaries, three possible ways of addressing these funding problems came into being: 1) an engineering supplemental fee; 2) appealing to chief executive officers in companies across the state for their support in a tax increase for higher education, and 3) a proposal of matched funds that the Missouri Society of Professional Engineers is bringing to the state legislature.

The idea of a supplemental engineering fee was initially proposed in 1982. The first fee recommendation was $40/sch (student credit hour). This was seen as one way of easing the equipment and salary problems that the UMC College of Engineering had been experiencing for some time. With the influential support of alumni, members of the Missouri Society of Professional Engineers, the Deans of the Colleges of Engineering at UMR and UMC, and the Engineering Student Council, the Board of Curators approved a $10/sch rate for all resident engineering courses at UMC. This fee increase has been effective since the summer session of 1983, with a recent increase to $11/sch this fall. At the same time that the original supplemental fee went into effect, a loan fund was developed for those students who would not be able to meet tuition costs because of the fee increase.

UMC Chancellor Barbara Uehling views the engineering supplemental fee as just another source of revenue to the university in general, not the College of Engineering in particular; all funds are dispersed according to need only. The same position is taken toward the supplemental fees paid by the other professional schools, i.e., law, medicine, and veterinary medicine.

Even so, the College of Engineering receives approximately $410,000/yr. of the $420,000/yr. generated by the supplemental engineering fee (see Table 1). A total of $200,000 has been allocated on a yearly basis for operating expenses of the Engineering Computer Network (ECN). The engineering faculty received an average 10% raise while the campus-wide salary increase was 8%; this 2% difference amounts to a total of around $120,000/yr. And finally, the university made a $90,000 payment on the engineering loan for the ECN.

The UMC College of Engineering receives $410,000 to $420,000 per year generated by supplemental fees.

Although the new revenue to the College of Engineering does not come directly from the engineering supplemental fee, the additional funds would not have been allocated if the supplemental fee did not exist.

Table 1. NEW FUNDS TO THE COLLEGE OF ENGINEERING 1983-1984

$200,000	ECN Operations
120,000	Salary Increase
90,000	Payment of Debt
$410,000	New Income to Engineering

All of Missouri's higher education institutions, including UMC, are drastically underfunded. Since the College of Engineering gets a proportionate amount of the funds appropriated to UMC, this means that the College suffers from a lack of monetary resources as long as UMC does. A comparison of Missouri's support to higher education per $1000 of personal income to the rest of the states shows that Missouri ranks forty-fourth (see Tables 2, 3).

Information is available which shows how Missouri rates when compared to the states surrounding it in terms of appropriations per $1000 of personal income for higher education (see Table 4).

Two other sources of possible revenue to the College of Engineering are also being explored. The president of the Missouri Society of Professional Engineers (MSPE), Dr. Kimel, recently appealed to approximately 800 chief executive officers across the state asking for their support of a $4 per $1000 personal income tax increase for higher education at the direction of MSPE. MSPE is also proposing that the state legislature establish a matching funds program for equipment for the two state-supported engineering programs. If accepted, the state would match every dollar raised from external sources with state funding up to a maximum of $1200 per B.S. graduate. With the approval of these two programs, funding of higher education in Missouri would be assured of moving from its rank of forty-fourth nation-wide to at least the national average, and greatly decrease the funding problem that Missouri universities are experiencing.

Table 2. HOW MISSOURI IS SUPPORTING HIGHER EDUCATION 1983-1984

Missouri appropriations per capita	$ 73.49
National average of 50 states	115.29
Rank of Missouri among the 50 states	47
Missouri appropriations per $1000 personal income	$ 6.98
National average	10.45
Rank among 50 states	44
Missouri ten-year increase in appropriations	101%
National average	173%
Rank among 50 states	45
Missouri ten-year gain (loss) less inflation	(11%)
National average	21%
Rank among 50 states	45

"Chronicle of Higher Education," October 26, 1984.

Table 3. MISSOURI'S STATE AND LOCAL TAX BURDEN 1982

	Taxes Per Person	Share of Personal Income
Missouri State and Local Taxes	$ 843	8.7%
National Average	$1175	11.1%
Rank among 50 States	50	50

"U.S. News & World Report," Dec. 26, 1983/Jan. 2, 1984.

Table 4. MISSOURI'S SUPPORT COMPARED TO EVERY STATE CONTIGUOUS TO MISSOURI

Iowa	$11.88	Arkansas	$ 9.87
Nebraska	$11.35	Tennessee	$ 9.14
Kansas	$10.88	Kentucky	$11.97
Oklahoma	$11.22	Illinois	$ 7.73
Missouri	$ 6.98		

"Chronicle of Higher Education," October 26, 1984.

Tables 2-4 indicate how Missouri supports higher education and how this support compares to the nation and states bordering Missouri.

Engineering at Mizzou . . . the Watchword is Quality

by Jim Berquist

To produce the highest quality graduate, an educational program requires quality materials be put into the program. Two of the most important of these materials are quality students and quality faculty. The College of Engineering at UMC has both.

The high quality of the students is evidenced by the high scores achieved by UMC engineering students on college entrance examinations. In the fall of 1983, 35 percent of entering UMC freshmen scored in the top 10 percent of these test scores. The campus average was 19.1 percent. Over 68 percent of the freshmen engineering students were in the top 25 percent. This is compared to a campus average of 48.1 percent. The College of Engineering is the only school or college whose freshmen students are above the campus average. The engineering upper class (juniors and seniors) also lead the campus on nationally accepted test scores. Nearly 38 percent of the upper division engineering students were in the top 10 percent on the test scores, and over 71 percent were in the top 25 percent. This compares to campus averages for upper division students of 21 percent for the top 10 percent, and 49.6 percent for the upper 25 percent.

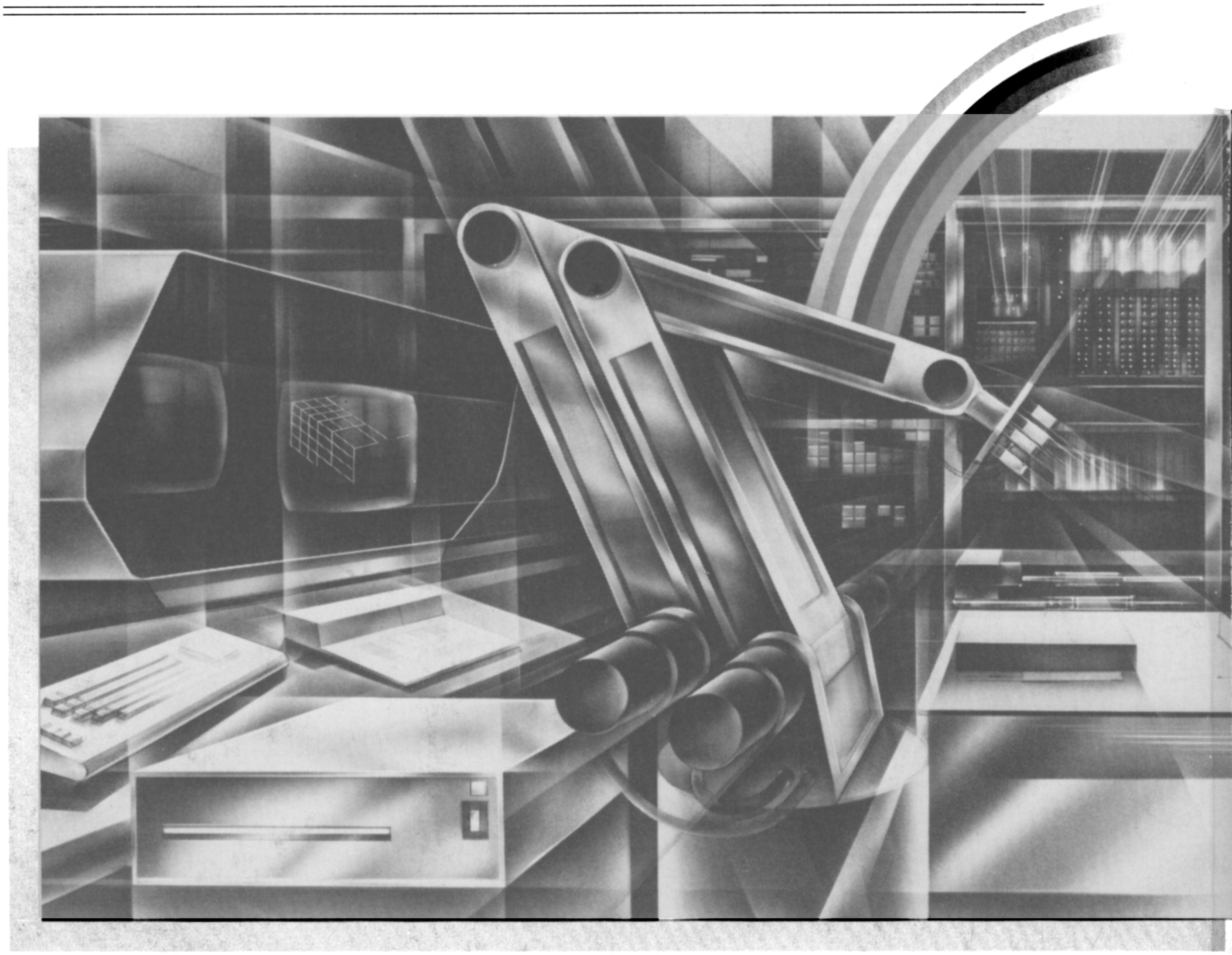
The college also had 36 National Merit Scholars enrolled in the fall of 1983. This number is equal to or greater than the total number of merit scholars enrolled in some major universities. This attraction of such high quality students indicates that UMC programs are perceived as being of high quality, that the campus-wide recruitment of quality is effective, and that engineering is an attractive field to capable young people when making career choices. In the fall of 1983, 37 engineering students were named to "Who's Who in America" based on their outstanding academic records,

leadership qualities, and extracurricular activities.

Faculty quality continues to be a source of pride for the college. More than 94 percent of the faculty hold earned doctorates representing 47 institutions. Over 10 percent of the engineering faculty have achieved Fellow status in their respective professional organizations, an impressively high number. In addition, the UMC College of Engineering was the recipient of the 1984 Koeper Award. (See story, p. 3, this issue.) This award was given by the National Society of Professional Engineers (NSPE) to recognize the school's outstanding commitment to engineering professionalism and ethics.

Other honors to the College of Engineering include having the only two scientists in Missouri to receive the Presidential Young Investigators Award on the faculty. These two recipients are Mark Prelas, assistant professor of nuclear engineering, and Eric Sandgren, assistant professor of mechanical and aerospace engineering. These two were among the first 200 university scientists and engineers in the nation selected by the White House Office of Science and Technology to be named 1984 Presidential Young Investigators. The college has also been given 4 of the last 24 AMOCO teaching awards, 8 of the last 60 Faculty/Alumni Awards, the Chancellor's Research Award, 2 of the last 11 Sigma Chi Awards, and the Byler Award. All of these honors are indicative of the high quality of UMC engineering faculty.

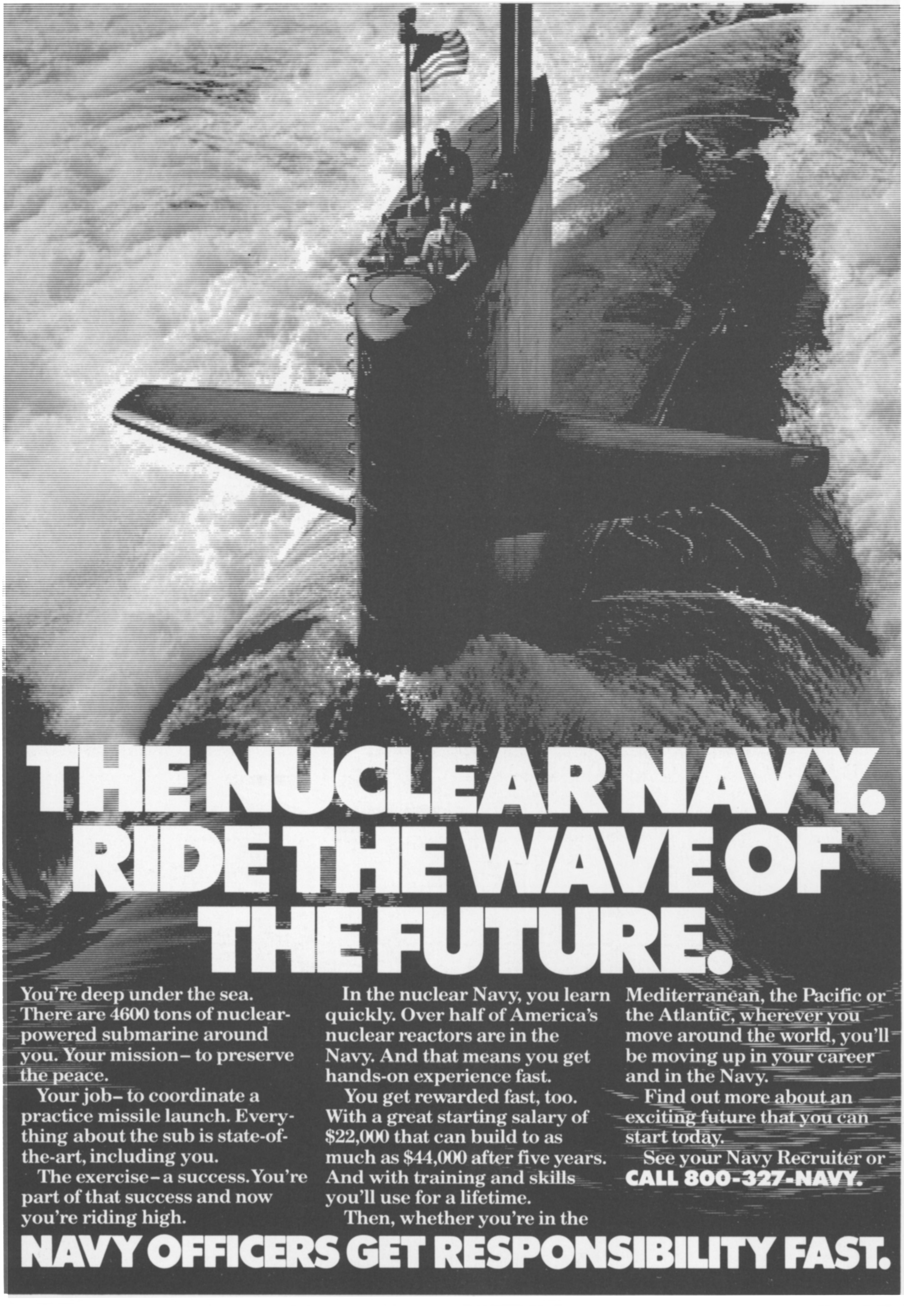
Probably the best and final, measure of UMC's educational programs is what graduates do after leaving UMC. Baccalaureate engineering degree graduates continue to do well in placement. December 1983, graduates reported average salaries of $25,068 per year. This increased the following semester, with Winter 1984, BS graduates in engineering reporting average annual salaries of $25,860. Interview activities also increased with 24 percent more companies on campus in the winter of 1984 than in the winter of 1983. Equally impressive is a list of some of the accomplishments of past UMC graduates. For instance, the presidents of companies like Agico, Booker, Frisco, Panhandle Eastern, Fort Worth and Denver Railroad, Belt Railway of Chicago, Farmland, Sverdrup and Parcel, and Bell are all UMC engineering graduates. Other companies like Monsanto, Hooter, McDonnell-Douglas, Anheuser-Busch, ARMCO, GE, Hughes, GTE, and Williams have our alumni in positions of vice-president. The list of outstanding graduates goes on, with each success reflecting back on the quality of UMC engineering programs.



Missouri

SHAMROCK

Feb./March 1985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Missouri
SHAMROCK

The UMC College of Engineering Magazine

Feb./March 1985 Vol. 78 No. 2

contents

The Missouri Shamrock is published three times annually (Nov/Dec, Feb/March, April/May) by the engineering students of the UMC College of Engineering. Opinions stated herein do not necessarily reflect the views of the College of Engineering.

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Foremost, the Missouri Shamrock acknowledges its advisors, Robert W. Leavene, Jr., Associate Professor of Electrical and Computer Engineering, and Annette Sanders, Director of Engineering Communications, UMC College of Engineering.

Dedication

How many organizations are you a member of? Now for the big question, how many of those organizations are you truly a member? Do you try to go to all of the meetings? Do you participate at the meetings? Do you volunteer for committees or fund raisers? Or is being a member of this organization just something to pad your resume?

These are questions that I have asked myself and have come to the conclusion that I am truly dedicated to only one organization, the MISSOURI SHAMROCK. I belong to many organizations but I cannot truthfully say that I am dedicated to them. I guess you could say that I'm dedicated to school and to getting my degree, but aren't most engineers? If they're not, they usually don't stay in engineering very long.

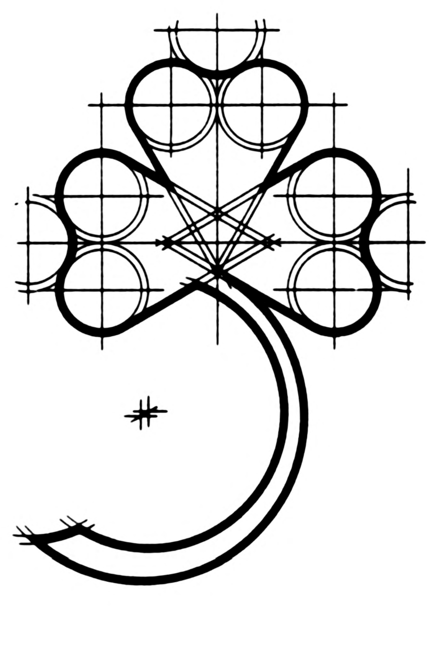
I believe dedication is a problem with most engineering students. I always hear the excuse, "I've got to study" or "I just don't have time," which are just plain cop-outs. I don't know too many students that don't have to study or who have time to burn. Except for the executive members of the organizations on campus, very few members are dedicated to the organization. This is a real problem because an organization with no dedicated members is essentially useless. One or two people cannot make an organization function smoothly; it needs **dedicated** members.

Why don't we do ourselves a favor and give some time and effort to at least one organization?

I don't think you'll be sorry.

Jim Kernell

Jim Kernell, Editor
Missouri Shamrock



Part I History of Licensure (Professional Registration) in Missouri

by William R. Kimel and Cyrus O. Harbourt

Missouri's first engineering registration law was enacted in 1941. It defined the **practice of engineering** as "any professional service, including consultation, investigation, evaluation, planning, designing, preparation of plans and specifications, or the responsible laying out, inspections, and acceptance of any construction or operation in connection with any public or private utility, structure, building, machine, equipment, process, works, or project to be constructed or put into operation within the State of Missouri, wherein the public welfare, or the safeguarding of life, health, or property is concerned or involved, when such professional service requires the application of engineering principles or data."[1] The 1941 law further required as one condition of eligibility to be a registered professional engineer, "Graduation from an approved course in—professional engineering in a fully accredited school or college approved by the Board as of satisfactory standing . . ." There were certain alternative provisions in that original law, but the preferred connection between accreditation of engineering degree program and professional registration was clear from the start in Missouri. This is remarkable because the accreditation of engineering programs was itself a new concept at that time (1941). The earliest accreditation decisions in the U.S. were rendered in the mid-to-late 1930's.

In 1959, the Missouri registration law contained an educational condition of eligibility virtually identical to the 1941 law and quite specifically referred to ECPD accreditation. "Engineering" and the "practice of engineering" were defined in 1959 in shorter and less informative statements. Engineering was "the art and science of engineering as defined, outlined, and treated in engineering textbooks and as included and taught in the engineering curricula of schools and colleges." Its practice was "rendering or offering to render any service, for gain, which requires, or would require, the application of the art and science of engineering in any of its branches and fields."

These somewhat circular and loose definitions gave way along with the rest of the law existing in 1969 to a completely rewritten new statute which:

(1) much more specifically defined the practice of engineering, using some of the 1941 words and adding for the first time explicit reference to "engineering teaching of advanced engineering subjects or courses related thereto" as part of engineering practice; and

(2) set January 1, 1977 as a deadline date for the closing of alternatives to graduation from an ECPD accredited program as a prerequisite to professional registration.

This apparently complete elimination of alternatives led to various efforts to restore some kind of Board-controlled determination of an appropriate equivalent to the strict accredited degree path. Several minor refinements followed, leading to the currently (1984) applicable wording, "Any person may apply to the board for . . . registration . . . who is a graduate of and holds a degree in engineering from an accredited school of engineering, or who possesses an education which includes at the minimum a baccalaureate degree in engineering, and which in the opinion of the board, equals or exceeds the education received by a graduate of an accredited school . . ." The Missouri Board currently employs the services of expert consultants in evaluating the "equals or exceeds the education received . . ." aspect for each applicant it considers who does not hold an ECPD/ABET accredited degree.

A 1983 NSPE document, *State by State Summary of Requirements for Engineering Registration*, says, "As a general rule every state (considers applicants) who graduate from a four-year approved engineering program . . .", and notes that "the state boards basically rely upon the engineering programs accredited by the Accreditation Board for Engineering and Technology; but may approve others as having equivalent standing." It is virtually impossible to precisely identify any number of states as **requiring** an ABET accredited degree as a prerequisite to engineering registration at this time. There are many variations of alternative paths. Missouri is surely one of the "strict constructionist" states in this regard. Dr. Paul Munger, last year's president of the National Council of Engineering Examiners, the consortium of state registration boards, has recently informed me that the prevailing tendency among the states has been to stiffen the requirements, rather than loosen them in recent years.

At least since 1959 in Missouri, and

continued page 16

[1]Vernon's Annotated Missouri Statutes (1959), 327.020.

UMC NE Department Successfully Completes First Phase of Fusion Research Project

by Bruce Hamby

On September 26, 1984, researchers from the University of Missouri-Rolla, McDonnell Douglas Astronautics, and the Nuclear Engineering Department at the University of Missouri-Columbia succeeded in producing what was probably the largest plasma ever generated in Missouri to that date. That success was the culmination of a summer's effort by researchers to get the preliminary Missouri Magnetic Mirror Project working. The Missouri Magnetic Mirror Project (MMM) is managed by the Nuclear Engineering Department at UMC and involves researchers from the McDonnell Douglas Astronautics Co., Fusion Energy Program, the University of Missouri-Rolla, and at UMC, most of the departments within the College of Engineering as well as the Chemistry and Physics Departments.

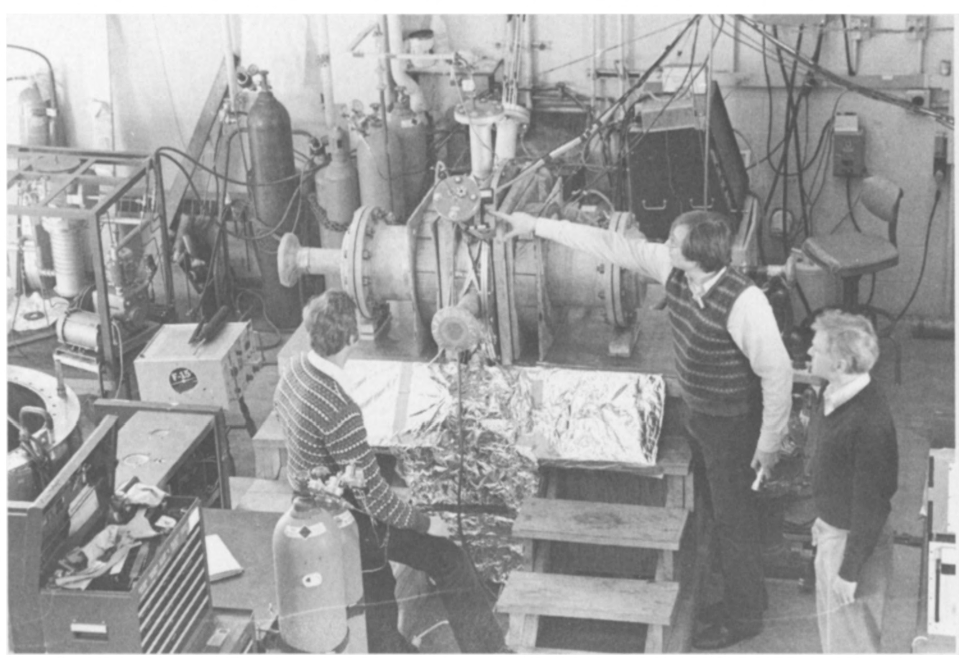
"the largest plasma ever generated in Missouri to date"

One of the main objectives of the MMM project is to try to demonstrate a magnetic field geometry that, when combined with the effects of electron rings generated within the plasma, will lead to an increased average confinement time for particles of the plasma trapped within the magnetic fields of the plasma generator.

The recent success of the fusion energy research project is only the prelude to the design and construction of a bigger plasma generating device that will use large superconducting magnets for plasma containment. Its projected completion date is mid-winter 1985.

The apparatus used in the successful preliminary experiment used water-cooled copper magnets that could be arranged to give a magnetic containment field of either a cusp or a mirror geometry. (The cusp mode utilizes two opposed magnets approximately one meter apart, center-to-center. The mirror mode utilizes two magnets to produce an almost tunnel-like area between the magnetic field of force lines where the plasma is contained between the magnets.) The larger apparatus, which is now under development, will be built to operate in the cusp configuration but will be able to be converted to a mirror mode if desired.

The nuts and bolts of the actual preliminary experiment call for hydrogen gas under very low pressure to be introduced into an evacuated container called the plasma tube. The plasma tube is then bombarded by microwaves generated by a 2.4 gigahertz magnetron. At the very high temperatures thus achieved (on the order of 30 million degrees Celsius)

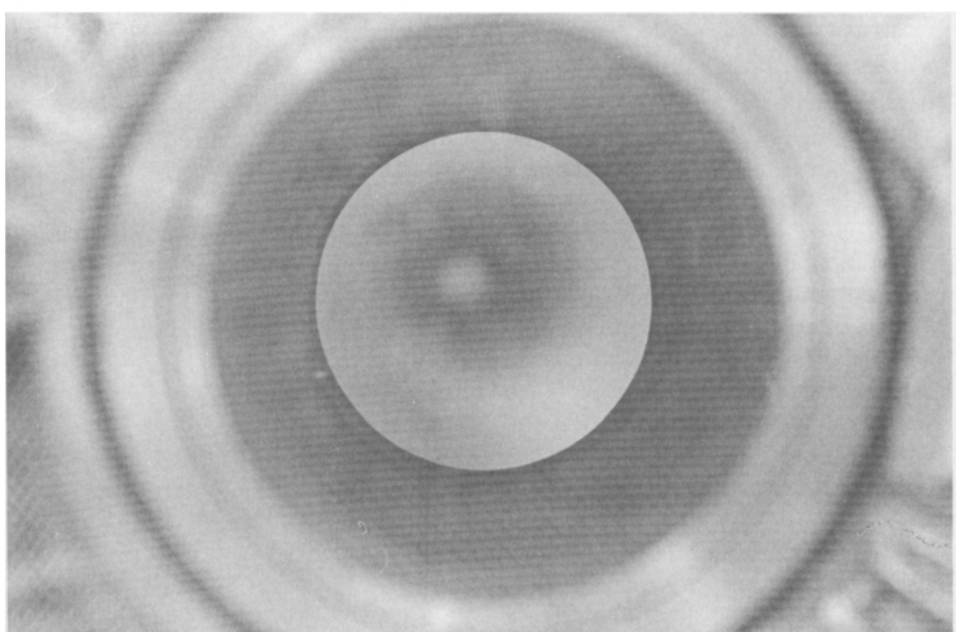


Researchers in the Missouri Magnetic Mirror Project (MMM) lab.

escape from the magnetic field. From this information they, in turn, calculate the average probable temperature of a particle in the plasma. Hopefully, the MMM project will ultimately demonstrate that average particle containment time can be increased by taking advantage of the geometry of the magnetic fields and the electron ring effect. This is important to fusion research because the longer a particle can be contained within the magnetic fields, the greater the chances are that it will undergo fusion.

A researcher views the plasma through a shielded port hole.

the molecular bonds between the hydrogen atoms are broken and the hydrogen gas is stripped of its electrons. The resulting mass of high energy electrons and ions constitute what is known as plasma. As the energy level of the particles continues to increase while the microwave bombardment continues, they finally have enough energy to escape the magnetic fields containing them. The intensity of the escaping free electrons (beta particles) cannot be measured directly, since they cannot escape from the plasma tube, so they are directed at another element where they undergo a nuclear reaction that results in the emission of gamma rays. These gamma rays can then escape from the experimental apparatus and their intensity is measured by the researchers. With this data, the researchers then calculate the intensity and the rate at which the electrons



The donut-shaped plasma was the largest plasma ever produced in Missouri.

Engineering Workstations: Powerful Engineering Tool

by Mourad Chihaoui

Engineering workstations—desktop computer systems almost as powerful as a minicomputer—have generated considerable excitement in the past two years. Engineering workstations can potentially be used to speed every aspect of the design engineer's job, from refining an initial concept to beginning full production. However, at more than $50,000 each, only a few thousand engineering workstations have been bought, causing their impact thus far on working engineers to be slight.

The usefulness of CAE (Computer-Aided Engineering) workstations depends on how companies employ them. Some companies say that the workstations are performing below their potential because the majority of the engineering users utilize only the drawing schematics capability rather than their ability to do extensive analysis and simulation on designs. It seems like the simplest work has replaced the more complex uses of the workstations.

However, some people say that potentially the entire production cycle could be changed by the availability of CAE tools for design. To some observers the creation of designs is a relatively small part of the potential area of impact of CAE workstations; more important may be the applications of computer-aided engineering techniques to the long term storage of design data. In traditional paper-based design methods, changing a design late in the production cycle can be very expensive and difficult because drawings must be redone and the entire design must be rechecked to ensure that the changes have not introduced new errors. If design data are kept in computer-readable form, then small modifications to fix "bugs" can be made without affecting the rest of the design.

The capability of keeping large amounts of information related to a design as well as the design itself becomes more important for projects where many engineers work on the same design. The workstation enables engineers to note important and unusual features that were encountered in their design, while decreasing the actual work time that would be necessary if using manual methods.

There are only two major drawbacks to workstations: testing and debugging and cost. Currently, testing and debugging of the designs must be done with separate equipment. Regarding the cost, it is hoped that as workstations become more widely used in the industry, support and training costs will decline making the workstation a more economical tool.

Engineering Computer Network

by Tracy Rubick

If you are an engineering student at UMC, then chances are you are either currently enrolled in a computer course or will be very soon. Perhaps you have become interested in computer-aided techniques such as Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), or Computer-Aided Testing (CAT). If this is the case, you have probably noticed that the batch processing offered at UMC is inadequate for these demands. Although batch processing does offer a wide variety of applications, it is not adequate for interactive, high-computing load applications required by upper-class and graduate engineering students.

It is for this reason there are changes being made.

A master plan has been developed to implement a comprehensive engineering computer network. What are these changes? What is the Engineering Computer Network?

According to a presentation given by Dr. Harry W. Tyrer, Electrical and Computer Engineering Department, the proposed Engineering Computer Network would better serve the need for advanced computing by the students. With this in mind, Tyrer listed five main objectives associated with the computer network system:

1. The system must be capable of high quality interactive graphics for use in Computer-Aided Design, image analysis, and other research and educational needs for graphics.
2. A moderate resolution interactive graphics facility is required for Computer-Aided Manufacturing to reduce the demand on the more expensive high resolution terminals and to represent experimental and simple graphics data.
3. To provide real-time data acquisition, analysis, and response in research and education.
4. To provide access to the system by personal computers.
5. To decentralize computer resources so that computer power is available where it is required.

Funds are currently being raised to finance this plan estimated at $3.2 million. UMC has committed $1.3 million with the remaining $1.9 million to be derived from fund raising (almost ⅔ of this sum has already been raised).

The new Engineering Computer Network physical layer is based on Ethernet architecture. Ethernet was chosen because of its moderately high speed (10 megabits per second) and its low cost. The network performs advanced computing, including graphics, data base applications, and data acquisition. Furthermore, the Digital Equipment Corporation was chosen as the primary vendor based on previous investments, availability of support staff and extensive data base of software available. There are, however, several processors from several different manufacturers used in the computer network.

The Engineering Computer Network has only recently become operational. Of the objectives listed for the network, only 1, 2 and 5 have been met. Work is in progress to provide on-line data acquisition and real-time data analysis capability.

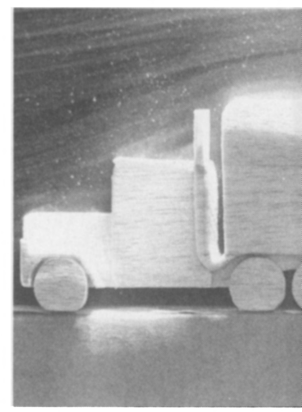
If, as a student, you find yourself discouraged by the limitations of the old batch processing at UMC, be patient! A completed Engineering Computer Network is just around the corner.

A Look Back at E

1

2

1. Jo Manhart, the "Egg Lady" representing the Missouri Egg Merchandising Council, provided the Grade A eggs in the catapult competition. 2. Chemical Engineering lab exhibits. 3. Contestant in the first annual Egg Catapult contest lines up his shot with a rifle sight. 4. Robotics display of the Rhino XR-1 which can be operated by a microcomputer. 5. Wind Tunnel model experiment demonstrated by Civil Engineering.



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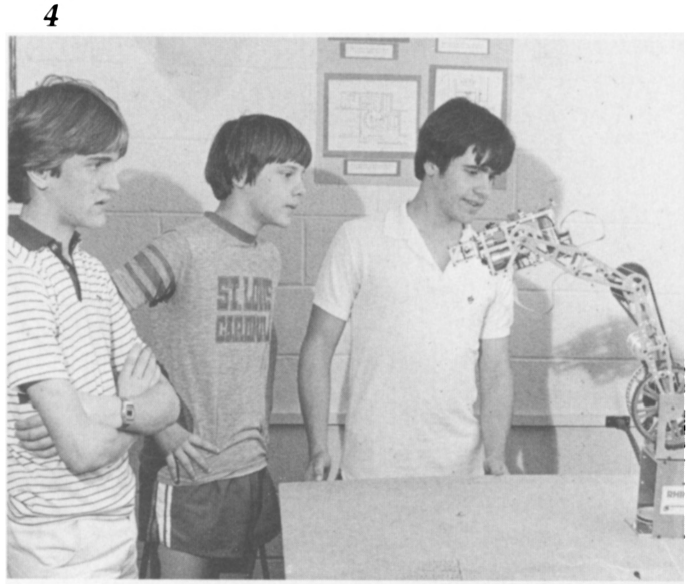

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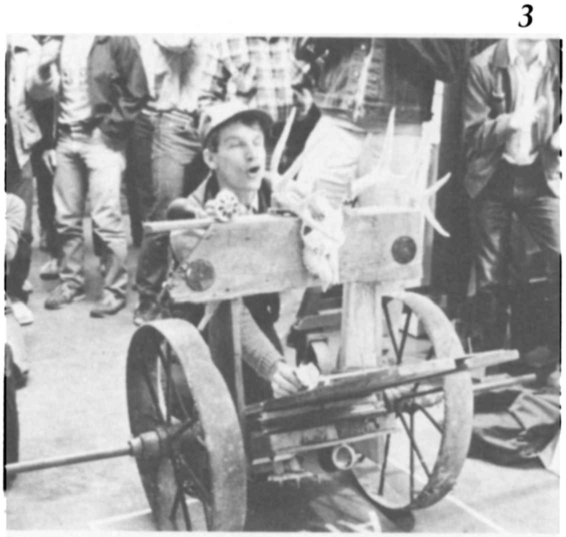

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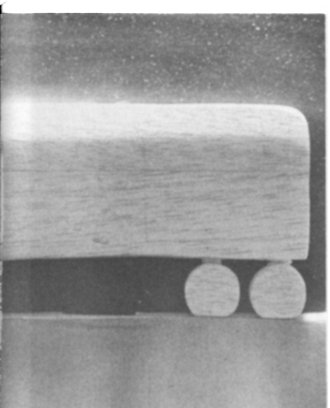

6. Missouri Honor Awards for Distinguished Service in Engineering. From left to right: Donald McPhee, Kansas City Power and Light; Neil L. Koelling, Fruin-Colnon Corporation; W.R. Kimel, Dean of Engineering; Kenneth Kolkmeier, Nooter Corporation; and Thomas Lafferre, Monsanto Company. 7. Computers get a workout from youngsters who toured open house. 8. Lester C. Webb received the Engineering Alumni "Citation of Merit Award." 9. Karen Jones reigned as Engineering Week Queen.

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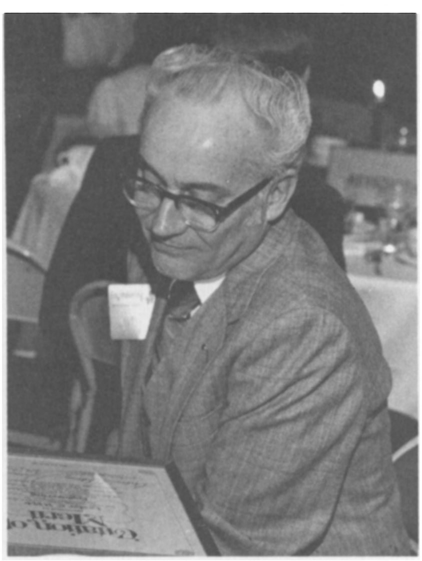
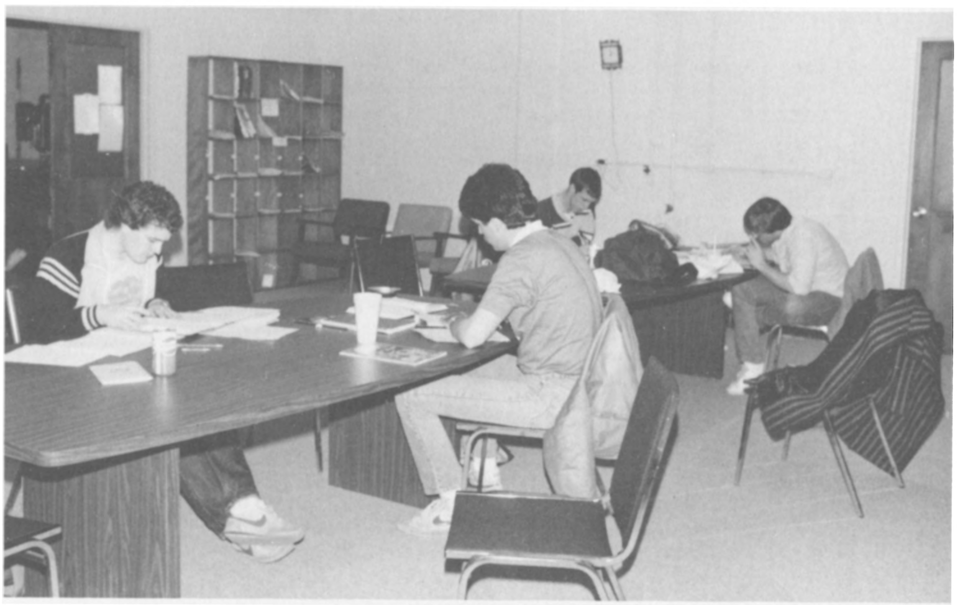


National Recognition for UMC American Institute of Chemical Engineers

by Melodie Rooker

Amy Meuse, the president of the UMC student chapter of AIChE (American Institute of Chemical Engineers), recently received the National AIChE Award of Excellence for 1983-1984 on the behalf of the chapter at the national convention in San Francisco in November, 1984. The UMC student chapter was one of thirteen awarded this national honor.

The recipients were chosen on the basis of professionalism, enthusiasm, and participation by chapter members. The amount of professionalism that a chapter exhibits is based upon the quantity and quality of chapter meetings, plant trips, and other chapter sponsored activities. The chapter meetings were evaluated on their diversity as well as the valuable information that the meetings provided to the members.



Students take advantage of the comfort of the newly renovated AIChE student lounge.

The UMC student chapter had ten professional engineers speak at their meetings during the 1983-1984 school year. The speakers covered many subjects from "A Graduating Engineer's First Project" to "How to Write Your First Resume". The speakers were from companies such as the Monsanto Company, Procter & Gamble, International Paper, E. I. du Pont de Nemours & Co., and Mallinckrodt. The chapter also sponsored plant trips to Anheuser Busch, Mallinckrodt, and Procter & Gamble in St. Louis.

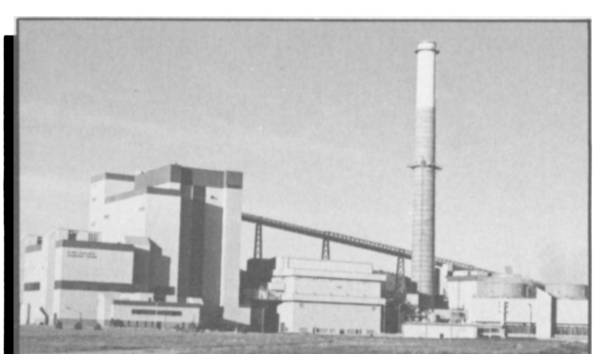
Officers from the chapter attended the 1983 regional meeting at Washington University in St. Louis, the 1983 national meeting in Washington, D.C., and the 1984 national meeting in San Francisco. The 1984 Mid-America Regional Conference will be hosted by the chapter April 12-14.

In addition, the chapter raised $3000 to renovate their student lounge through a telethon campaign, had several student socials, sponsored a roller kegger during Engineers' Week, and coordinated the chemical engineering laboratory exhibits which the chemical engineering department has taken the Dean's Trophy for the past two years.

The UMC student chapter of AIChE plans on continuing the tradition of student involvement and professionalism which has brought it national recognition in the recent past.

If anyone is interested in becoming involved in AIChE, stop by the Chemical Engineering office or see Dr. Paul Chan, the faculty advisor for AIChE.

LOOK AT OUR PAST
CAN YOU SEE YOUR FUTURE?



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Civil Engineering Transplants Bridge

by Layli Alexander

Professor Harold Salane (left), UMC Civil Engineering professor and co-investigator of the project, is interviewed by WDAF-TV.

Nearly half of the United States bridges are in need of major repairs, according to the Federal Highway Administration. Included among these is the Kansas Inter-City Viaduct. Located along Interstate-70, the inter-city viaduct carries traffic between Kansas City, Missouri and Kansas City, Kansas.

In 1981, an inspection by the Kansas Department of Transportation found fatigue cracks (some as long as 16 inches) in the girders of the westbound viaduct. Fatigue cracks develop as a result of repeated loading. After many cycles of loading, small cracks form and propagate, decreasing the cross-section of the girder until the girder eventually cannot support the load.

After this routine inspection, the cracks found in the girder were immediately welded. But because of a lack of research about this type of bridge, it could not be certified as safe. This lead to the replacement of a 1080 foot section of the viaduct.

Constructed in 1959, the inter-city viaduct was built to specifications of the Bureau of Public Roads. There are approximately 4000 - 5000 bridges of this type in use. Because most of these bridges are 15-20 years old not much is known about repair methods. The Kansas Department of Transportation felt that a study of the viaduct could lead to useful data that could be the basis for evaluating this type of bridge.

This lead to a three year study of fatigue loading on a 70 foot section of the Kansas Inter-City Viaduct by Dr. James Baldwin and Dr. Salane of the University of Missouri-Columbia's Civil Engineering Department. The salvaged section will be transported by truck and placed on the foundation built last summer at the Agricultural Engineering Research Farm.

Besides fatigue loading, the study includes strain deflection and static tests for stress patterns. Because the actual repairs were made on the viaduct, it will be possible to evaluate the effects of loading and possibly apply this information to other bridges built to this same standard design.

"From stress patterns it will be possible to suggest other ways to repair this type of bridge. These methods will also be implemented and tested," stated Dr. Baldwin.

Replacing the 1080 foot section of the bridge cost taxpayers approximately two million dollars. But safely repairing the bridge could cost less than half that amount.

The 70-foot section of the old I-70 West bridge is lifted onto a truck to go first to Mosher Steel Company in Kansas City, Kansas for some fabrication work, then to Columbia.

Was St. Patrick an Engineering Genius?

(Why St. Pat's Day Is a Special Day for Engineers)

by Ben Weinbach

Begorrah, 'tis true—nearly everyone looks forward to St. Patrick's Day as an occasion for fun, frolic and festivity.

But among all the celebrants thereof (and these include not only those of Irish descent, but members of many other ethnic groups and faiths who consider themselves "Irish for a day") there is a particular group for whom the day has extra special significance: engineers, and particularly, engineering students in many colleges throughout the land.

The reason for this goes back more than four score years to a warm, sunny St. Patrick's Day in 1903 on the campus of the University of Missouri at Columbia.

It seems a bunch of the boys, mostly freshmen in the University's College of Engineering, were whooping it up in front of the famous Mizzou columns on the University quadrangle. They had just decided that good ol' St. Pat had truly been an engineering genius, since who but an engineer could have developed the skill and energy to drive the snakes out of Ireland?

So—what more fitting than for engineering students to cut classes and enjoy a St. Patrick's Day holiday?

Legend has it that among the principal instigators of this unholy and outlandish behavior were three brash freshmen from St. Louis:

Mendell P. Weinbach, who after earning his Bachelor of Science and Master's degrees in electrical engineering, joined the Mizzou engineering faculty where he served more than 40 years as professor of electrical engineering and ultimately as chairman of the electrical engineering department;

Tom K. Smith, Sr., who achieved outstanding recognition as a St. Louis civic leader and long-time president of Boatmen's National Bank of St. Louis; and

James L. Hamilton, Sr., who joined Century Electric Company in St. Louis after his graduation and who rose to the post of vice-president of this nationally-known company.

The three were said to have been close friends who roomed in the same boarding house near the University campus.

Only Professor Weinbach remained in the academic world, attaining national recognition as author of several widely-used engineering textbooks. One of these, *Electric Power Transmission*, (published 1948, by The Macmillan Co.) depicted theories and practical methods for transmitting electric power at maximum strength over long distances, as, for example the transmission of power generated by Bagnell Dam in the Missouri Ozark country for the St. Louis area.

The first St. Pat's Day celebration by those maverick engineering students (frowned upon and resisted by the faculty) was only modestly successful.

But an irresistible force had been put into motion and by 1905, faculty resistance was nil and the entire College of Engineering student body was allowed to enjoy a St. Patrick's Day holiday.

The engineering faculty, believe it or not, even cooperated. Adding to the occasion was a faculty-sponsored exhibition of electrical, mechanical, chemical and civil engineering phenomena in the school's laboratories for the edification and entertainment of students other than engineers and for the Columbia townspeople as well.

"The first St. Pat's Day celebration by those maverick Engineering students was only modestly successful."

Early in 1906, amid excavations for construction of an Engineering Annex Building, a senior engineering student of Irish descent with the odd name of Veit Aull Hain discovered a genuine Blarney Stone bearing strange Gaelic hieroglyphics. These were deciphered as meaning "Erin Go Bragh" and testifying, it was determined, to the engineering status of St. Patrick himself.

The stone, approximately 30 by 18 by six inches in size (no one, not even engineers, has ever measured it precisely) was later reputed to have actually been a part of the real Castle Blarney in Ireland and secretly spirited to the Mizzou campus to be a part of the new Engineering Annex Building.

In honor of this great "discovery" the 1906 St. Pat's Day festivities were of truly memorable proportions.

First of all, there was the arrival on campus via an "airship" of a reincarnated St. Patrick, resplendent in flowing green robes, and carrying a crooked and wicked-looking shellalelgh.

As that day had dawned, drawings of squiggly green snakes appeared on Columbia sidewalks, symbolic of those driven out of Ireland by St. Patrick. The sidewalk snakes were gleefully followed by small boys all over town.

Lawyer - Engineer water fight in 1906 (Courtesy J.H. Barns)

A song "*St. Patrick Was an Engineer,*" sung to the tune of "When Johnny Comes Marching Home," was introduced and became the engineering students' theme song. The first of literally dozens of stanzas (many quite lusty and bawdy) ran as follows:

> "*St. Patrick was an Engineer,*
> he was, he was,
> For he invented the calculus
> And handed it down for us to cuss,
> *Erin Go Bragh,* 'rah for the
> engineers."

Finally, to top off the occasion, the great "Kow-tow" was performed on campus, to become forevermore a solemn ritual for Mizzou engineering students.

The reincarnated St. Patrick stood majestically on the steps of the Engineering Building. The students first prostrated themselves en masse on the bright green sod. Then each student came forward, knelt, kissed the Blarney Stone, and was dubbed by a touch of St. Patrick's shellaleh as a "Knight of St. Patrick."

Traditionally, each year thereafter, the conferring of "Knighthood" upon senior engineering students became a St. Pat's Day feature.

Later, the practice of conferring "Knighthoods" upon deserving patrons of St. Patrick began. Over the years such dignitaries as governors, U.S. Senators, presidents of the University, and other notables have been so honored.

The Blarney Stone, amazingly, disappears in a cloud of green chemical smoke after each "knighting" ceremony - then mysteriously reappears the next St. Pat's Day.

Also amazingly—and certainly undreamed of by the original group that started it all—the celebration of St. Patrick's Day by engineering students spread to many campuses, from M.I.T. to the University of Southern California, from the Gulf states to the Great Lakes, and elsewhere.

The annual event, sometimes designated Engineers' Day, or even expanded occasionally to Engineers' Week (as at Washington University in St. Louis) provides opportunity for engineering exhibits as well as lectures by prominent scientists, alumni, and others.

St. Patrick first appeared on campus during Engineering Week in 1906. (Courtesy Wm. H. Floyd, III)

Ironically—and completely unknown to the students in 1903—a perfectly legitimate reason existed for celebrating the *17th of March* as a campus holiday.

For it was on March 17, 1863 (40 years earlier to the day) that the State of Missouri legislature in General Assembly accepted and approved the endowment by the Federal Government of land in Columbia for a College of Agriculture and Mechanical Arts at the University.

This action ultimately led to the creation of the two notable and internationally-acclaimed University divisions—the College of Agriculture and the College of Engineering.

Erin Go Bragh—hurrah for the Engineers!

(Ben Weinbach, a son of Prof. Mendell P. Weinbach, is the former director of advertising for ITT Aetna Finance Co. and is now retired.)

History

Continued from p. 3

in most other states, exemptions from the requirement of registration exist for engineers who perform "professional engineering work under the direction and continuing supervision of and (are) checked by one holding a currently valid certificate of registrations." Most state laws also provide for a so-called manufacturer's exemption for regular full-time employees engaged in manufacturing operations and whose engineering work relates to the manufacture, sale, or installation of the employer's products. Though these are two separate categories, they are similar enough in intent that they would tend to rise or fall together. Incidentally, Missouri law is currently interpreted to allow non-registered persons to teach engineering courses so long as the responsible academic official (i.e., the Dean of Engineering) is registered.

The current Missouri registration law is consistent with its own antecedents and generally in line with other state laws. It is in no sense unusual or capricious. It continues and reinforces the historical relationship between engineering accreditation and engineering registration.

The competence of persons to practice engineering in a professionally responsible manner is directly related to the quality of their engineering education. Current events make it all too evident that engineers who design and develop products, processes and services must have a sophisticated engineering education and must be committed to their own continuing professional development by extending their education after graduation and by engaging in other professional activities.


Light Sculpture by Bill Parker
© Studio for Visual Technologies in
Fine Art New Canaan, Ct.

Missouri

SHAMROCK

April/May, 1985

Missouri
SHAMROCK

The UMC College of Engineering Magazine

April/May, 1985 Vol. 78 No. 3

contents

The Missouri Shamrock is published three times annually (Nov/Dec, Feb/March, April/May) by the engineering students of the UMC College of Engineering. Opinions stated herein do not necessarily reflect the views of the College of Engineering.

Subscription rate is $5.00 per year. Inquiries concerning subscriptions or advertising should be directed to Missouri Shamrock, College of Engineering, 1020 Engineering, University of Missouri-Columbia, Columbia, Missouri 65211.

Foremost, the Missouri Shamrock acknowledges its advisors, Robert W. Leavene, Jr., Associate Professor of Electrical and Computer Engineering, and Annette Sanders, Director of Engineering Communications, UMC College of Engineering.

Editorial:

The End

First I'd like to congratulate the graduating seniors on finally completing 4 years (maybe more) of engineering study. It seems like only yesterday (really a lot longer ago than that) that we were taking Engineering 5 and Physics 80, perhaps more than once, but now it is finally time to say good-bye to this sheltered academic life and get into some real learning. I hope that you have made the right career decision and you will be happy in your new lifestyle.

This final year of school (final for the second time) has gone faster than ever for me, especially with the added excitement of publishing the MISSOURI SHAMROCK. I am very proud of the accomplishments of this year's publications and especially of this final issue. I hope you agree that this is our finest work this year. None of this could have been possible, however, without the help of the staff, and especially Annette Sanders and Robert Leavene. Annette has been a great support the entire year with great ideas for articles and helping the magazine get back on its feet last fall. Dr. Leavene has been the "strong arm" for the SHAMROCK by recruiting much of the staff this year and next (just ask his ECE 216 class), and he has been a personal friend to me and the staff. I'd also like to thank Dean Kimmel for his continued whole-hearted support of the MISSOURI SHAMROCK.

Looking back on this year's Engineers' Week, the planning committee did an excellent job bringing everything together and getting the events organized. You guys and gals deserve a pat on the back. This year there seemed to be much more participation by the students and faculty. Participation is what makes Engineers' Week the most enjoyable. Classes seem to take on a whole new perspective after drinking beer with many of the professors at the Thursday night bar-b-que, or bidding for their services at the auction. After getting to know the faculty on a more personal basis classes seem just a little bit more interesting (I did say, "a little bit.").

Good-luck to next year's staff, I'm confident that the MISSOURI SHAMROCK will continue to prosper, or maybe just continue to function normally (as opposed to this year's operation).

A last word to the seniors — Take a piece of the columns with you wherever you go — Subscribe to the SHAMROCK.

Jim Kernell

Jim Kernell, Editor
Missouri Shamrock

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Star Wars at Mizzou—a Hovercraft

by Mark Schroder

In grade school John Gilman had a dream of building a hovercraft. So he came to the University of Missouri, received an education and built one as a Senior project. The primary goal of his dream was to break the world's land speed record for hovercraft. As of this printing John has not broken the speed record, due to minor design changes that are necessary, but theoretically his machine could more than exceed the record with its maximum expected speed of around 90 mph. The reason John has not had a chance to make the design changes is that upon graduating from the School of Mechanical Engineering this past December he had to move to California to accept a job with Hewlett-Packard.

Mr. Gilman's hovercraft is a plenum chamber type craft, meaning the craft's cushion of air that supports the craft off of the ground is kept under the machine by means of a specially curved skirt known as a plenum chamber. The weight the cushion of air can support is proportional to the volume of air in the chamber and the height above the ground the craft is hovering. John's design can support approximately 1500 pounds, but the hovercraft weighs only 900 pounds, so that the excess power generated by the Mazda rotary engine can go toward forward thrust.

John Gilman prepares his fiberglass on foam hovercraft for a test run.

John's hovercraft has a simple metal frame upon which a unique fiberglass over foam body is fitted. The Mazda engine powers two propellers, one in front and one in back, by means of two drive shafts. The forward propeller is used for blowing air under the craft to provide lift while the rear propeller provides forward thrust and directional control by vectoring the airflow through the use of vanes. Throttle control, ground friction and height of hovering are also used to control and stop the craft.

Hovercraft first appeared back in the early 1950's with several types of power schemes, however through the years one design has become prominant, it is that of the plenum chamber. The majority of research and design on hovercrafts has occurred in Britain, because they were looking for a craft that could be used as a ferry across the English Channel. A couple of reasons why we see hovercraft only in Star Wars movies, is that the problems of terrain versatility and a method of precise control have not yet been overcome. Perhaps in the future John's advice "I encourage any engineering student to undertake a project before they graduate", will be heeded and a solution to these and other problems will be found.

That First Job

by Jay Berquist

Graduation and the "real world" are just around the corner and with graduation there comes change. Many graduates will accept jobs that require an adjustment in their way of thinking. No longer will someone hand them six problems with the instructions to design six systems to rectify these problems, all in fifty minutes. Now the work will be done with a group of people working a lot longer than fifty minutes. Then again, mistakes do not go over as well in the "real world." In school a 70% would get a grade of C, B if the curve were lowered. At work one 70% correctly designed system could cost lives and your job.

This first job is also filled with other changes for the graduate. Getting to know large numbers of new people at work, setting different hours, having new living arrangements in a new town, possibly far from the parents home and boyfriends or girlfriends are all likely changes for the graduate. There are of course positive changes as well. Embarking on your career, learning new skills and being able to make future plans are positive changes that students look forward to being able to make. Of course having money to spend will be a long awaited and warmly welcomed change. Sometimes problems occur in this transition. Having a little information about these problems may go a long way towards avoiding them.

The job interview board once filled with interview schedules is now cluttered with summer sublease offers.

There exist many sources of information that deal with these school to first job transitions, one source is the career planning and placement center (CPPC). A few pieces of pragmatic advice on starting your first job were pulled from the book *College to Career.* Some of the book's advice on starting your first job is summarized here:

1) *Arrive at Work on Time.* This means actually planning to arrive early. You never know what kind of traffic you could run into.
2) *Get the Job Done.* Even if getting it done requires you to put in some overtime. A reputation of being "lazy" may haunt you a long, long time.
3) *Check in With Your Supervisor.* Find out from him exactly what you should do to get started.
4) *Become Acquainted With the More Experienced Employees.* These people are willing and able to

"Do not hesitate to jump right in and get your feet wet with your new job."

answer any question you might ask, or to give advice on how to get something done.

5) *Establish A Communication System.* This is especially true with your supervisor and communication must go both ways.

6) *Avoid Excesses.* This applies to such things as dress, mannerisms and even being friendly. Too much of a good thing is still too much.

Another source of information comes in magazines circulated throughout the school, like the *Shamrock*. One magazine called *Changing Times* ran a story titled "After You Get The Job, Then What?" In this story more pointers for dealing with problems encountered in this transition are given.

1) *Hard Work Counts.* This reinforces the earlier advice to get the job done. In addition, this article adds that your first job is not the time to overload yourself with too many outside activities. They may interfere with your job performance.

2) *Take the Time to do the Job Right.* If you hurry the job, the quality of what you turn in will suffer. Take the time to learn the proper way of doing things. This way you will not acquire a reputation as being someone whose ideas are half-baked or execution sloppy.

3) *Establish Your Integrity.* Earning respect on the job and building a strong reputation require that you be honest in your work and trustworthy in your dealings with other people, both on and off the job.

4) *Be realistic.* Do not expect a job to be void of routine, grubby or unpleasant chores. Also, do not expect to get a raise or promotion for every task well done.

Other sources of information are the recruiters that come to the campus. Bob Lackland of Texas Instruments has had a bit of first hand experience with school to job transitions. Mr. Lackland is a manager of procurement assurance at TI. He agreed that this transition can be a difficult one to make. Here are some of his observations:

1) Some of the new people coming in are high expectors while others are insecure. The high expectors have an exaggerated view of what they can accomplish, whereas the insecure may be overwhelmed by their new responsibilities. Managers must recognize the differences in employees and take an active part in getting that employee to adjust to the new environment and associated responsibilities.

2) If you plan to relocate, do not expect it to be peaches and cream. Mr. Lackland feels that TI is very lucky because it has a large number of people relocating to the Dallas area. With many people going through the same relocation process, it makes it easier to make new friends.

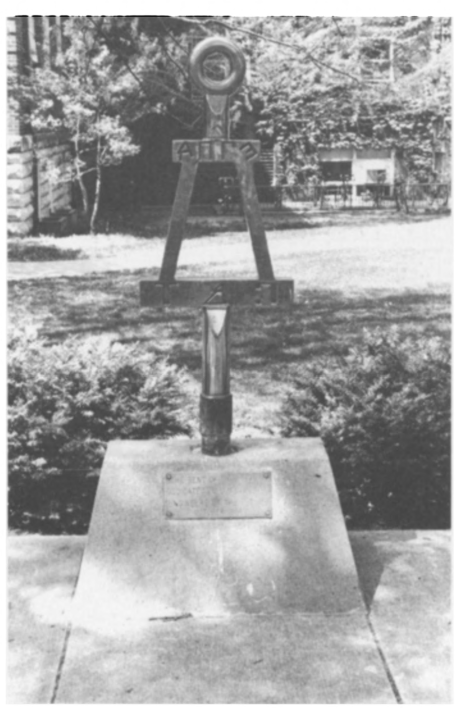
3) Mr. Lackland feels that communication and interpersonal skills are essential to successfully adapting to your new work environment. Getting involved in activities helps the adjusting, while also improving these interpersonal skills.

Dennis Wagner, a personnel staff manager at Southwestern Bell had some additional comments on the first job transition.

1) Keep in mind that the transition is on both sides. Your coworkers and supervisors are adapting to you as you try to adapt to them.

2) Many people come in expecting to do a lot in a short period of time. You are being hired to do a job and you should not expect, or be expected to, know everything on the first day. Expecting to know everything on the first day would be like trying to take a test on the first day of class.

Hopefully, this little bit of information will be of some help to those about to graduate and make this transition. This transition is a major one for everyone and should not be taken lightly. But, as Professor Bluedorn of Management 202 fame has been known to say, "Do not hesitate to jump right in and get your feet wet with your new job." Jumping right in will help you to adjust quickly and give you the necessary start to a successful career.



The Bent of Tau Beta Pi Dedicated to Outstanding Engineers of the Future October 1964.

Engineering King and Queen Crowned

by Mark DeYoung

After a busy week of banquets, field trips, luncheons, and entertainment with the Engineering Week king and queen candidates, the selection process reached its climax on Saturday, March 9, when John Tierney and Donna Mercier were crowned 1985 king and queen at the St. Pat's ball.

Donna is a junior from Rolla, Missouri and has a double major of Elementary and Early Childhood Education. She was sponsored by Pi Beta Phi sorority. John, sponsored by the Society of Women Engineers, is a junior from St. Louis majoring in Industrial Engineering. After advancing through three rounds of interviews, Donna and John competed against four other candidates throughout Engineer's Week. In that week the candidates and their escorts from the Engineers' Club took part in various activities, creating support for the College of Engineering.

"I've never done so many different things during one week of college!" sophomore king candidate Bart Eppenhauer said.

Some of the week's events included field trips to Kansas City where the candidates met Mayor Richard Berkely and to Columbia City Hall where they met Mayor John Westlund. They also traveled to Jefferson City and witnessed Governor John Ashcroft's official proclamation of March 2-9 as St. Pat's Week at Mizzou. In addition to the trips, the candidates assisted with the Road Rally and Barbeque, performed skits, and were guests for the Alumni Association and Special Awards banquets held during Engineers' Week.

John commented on the busy week. "It was the most enjoyable week of my college career to date," he said. "I had the opportunity to meet some wonderful people."

The St. Patrick's Board, and Engineers' Club committee in charge of organizing the week, arranged all the activities for the candidates. "I was really impressed with the student involvement," Donna said. "St. Pat's Board really put a lot into the week and did so many nice things for us." The Board members in charge of the king and queen selection were Krissa Pavlopoulis and Tim Kellis. The other queen candidates were sophomores Wendy Bishop, Tammy Clapham, Marilee Schweitzer, and Heidi Snelling. King candidates were juniors Jerry Berg, Mark DeYoung, Tim Gleason and sophomore Bart Eppenhauer.

The 10 candidates ham it up during the St. Pat's Ball just after Coronation.

CHEM E'S Retain Dean's Trophy Once More

by Mourad Chihaoui

For the third year in a row, the Chemical Engineering Department captured the Dean's Trophy for the Engineering Laboratory Exhibits Competition.

Five judges from the local 3M and Square D Companies gave the Chemical Engineering Department a score of 255 out of a possible 300, the Electrical & Computer Engineering Department 246, the Nuclear Engineering Department 242, the Civil Engineering Department 239, and the Mechanical Engineering Department 203. Each department was judged on 6 criterion: appearance and neatness, application of engineering principles, potential usefulness to industry or society, student contribution to development and presentation of the exhibit, clearness of presentation, and overall impressiveness of unit (department).

The exhibits were a display of various engineering applications. The following are just some of the exhibits displayed: semiconductor manufacturing in chemical engineering, a student-built car in mechanical engineering, a completely solar-powered town in civil engineering, a computer simulation model of a nuclear reactor in nuclear engineering, and robotics in electrical engineering.

Multitudes of Honorees

by Greer Barnard

The 1985 Missouri Honor Awards Reception and Banquet was held the 8th of March in the Holiday Inn Regency Ballroom. The tradition of the Missouri Honor Awards for Distinguished Service in Engineering dates back to the year 1951 when the medal presented to the recepients of the award was designed. Dean Kimel presided over the proceedings with an invocation given by Assistant Dean Jack W. Morgan, and a welcome from Chancellor Barbara Uehling.

Dean Kimmel presented the following people with the 1985 Honor Award for Distinguished Service in Engineering:

Raymond M. Butcher,
Executive Partner and Manager; Engineering Power Division, Black and Veatch; Kansas City, MO

Bruce M. Davidson,
Academic Dean; Department of the Navy, United States Naval Academy; Annapolis, MD

Ralph J. Denton,
President and Owner (retired) of the R. J. Denton Company; Syracuse, NY

Donald J. L. Lin,
President and Chairman of the Board; Qilin, Inc.; Dallas, TX

Kurt Pfahl,
Corporate Director; Corporate Technical Research and Engineering, Hallmark Cards, Inc.; Kansas City, MO

Jay McGarraugh received the 1985 Engineering Development Fund Excellence in Teaching Award, also presented by Dean Kimel. Dr. McGarraugh has been part of the University of Missouri-Columbia staff since 1967. Respected by both colleagues and students, Jay McGarraugh was described as cheerful, optimistic, empathic, competent, and conscientious. Organized, interesting classes, and availability to students were also cited as attributes leading to the choice of Jay McGarraugh as the recipient of the teaching award.

The Engineering Alumni Organization Citation of Merit was presented to James E. Moulder by Bob Crabtree, President of the Engineering Alumni Organization. This award was followed by a special gift from the Weinbach family. Ben Weinbach presented the College of Engineering with the renowned number one prototype 22 inch Log Log Vector Slide Rule designed by his father Professor Weinbach.

Left to Right: Denton, Davidson, Butcher, Ken Ragsdell, Pfahl and Lin prepare to be formally knighted during Engineers Week.

The honors began with the presentation of the Missouri Shamrock Recognition Award to Jim Kernell by Cy Harbourt. Amy Meuse presented the American Institute of Chemical Engineers Outstanding Sophomore and Senior to Lee Struglia and Ann Itterly respectively. Matthew Nixon received the Eta Kappa Nu Outstanding Sophomore Award presented by Jon Watkins. The Pi Tau Sigma Outstanding Sophomore Award was presented to Andrea Wilhelm by Amy Meuse.

The Institute of Electrical and Electronic Engineers honored Jon Coker with the Outstanding Member Award presented by Charles Slavinsky. Chi Epsilon's Outstanding Sophomore Award was presented to Ellen Gandl by Chris Haller. John Freeman presented Bob Joslyn with the American Nuclear Society "Service to Nuclear Science" Award. Brian Smith received the American Society of Agricultural Engineering Outstanding Sophomore Award presented by Roy Hessemann.

The following students also received honorable mention in recognition of being chosen by the College of Engineering Student Council to be elected to Who's Who: Louis Burgin, Thomas Finkey, Roy Hessemann, Michael Stiefermann, Gary Roesner, Michael Anderson, Jonathan Watkins, Stewart DeVilbiss, Daniel Wilding, Daniel Bexten, Sharon Baronzinsky, Clinton Snyder, Greer Barnard, Kristen Watkins, Rick Winegar, Beth Monschein, Gary Ehrhardt, Timothy Kellis, Allison Stiles, Elaine Custodio, Melodie Rooker, Charles Thien, Michael Knox, Kevin Cruise, Lawrence Turpin, Betram Tsutakawa, Tay Lily, Dawn Painter, Deborah Jensen, Christopher Harris, and Jeffery Hite.

The Reflective Vision

A highly advanced design tool developed at the General Motors Research Laboratories uses computers to generate visual images from mathematical data with such accuracy that, soon, in-depth aesthetic evaluations of new concepts may be made prior to creating a costly physical model.

Interactive Display

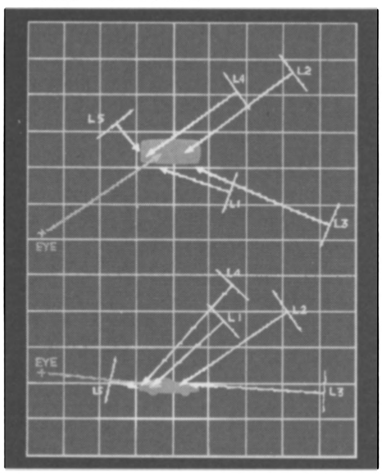
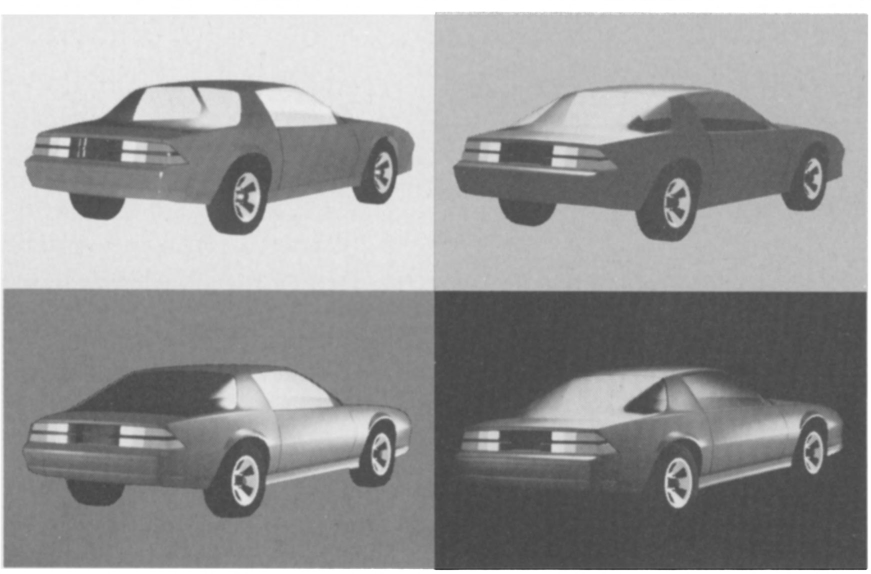


Figure 1: Computer display of plan view (upper) and side elevation (lower), indicating automobile location, lighting selections (L1-L5), and viewing position (EYE).

Figure 2: Four Autocolor images, showing the same view of an automobile as background and lighting change.



WITH AUTOCOLOR, users can synthesize three-dimensional, shaded images of design concepts on a color display and then quickly explore how major or minor changes affect the overall aesthetic impression. The system is completely interactive. By choosing from a menu on the screen, the designer can redefine display parameters, select a viewing orientation, or mix a color. Each part of an object can be assigned a surface type with associated color and reflectance properties. Built-in lighting controls generate realistic "highlights" on simulated surfaces composed of differing materials.

Before developing the system, David Warn, a computer scientist at the General Motors Research Laboratories, observed the complex lighting effects achieved in the studio of a professional photographer. By simulating these effects, Autocolor can produce results unattainable by conventional synthetic image display systems. Previous systems used a point source model of light, which allows adjustments only in position and brightness.

The versatility of the lighting controls constitutes a major advance in Autocolor. An unlimited number of light sources can be independently aimed at an object and the light concentration adjusted to simulate spotlight and floodlight effects. The lighting model even includes the large flaps or "barndoors" found on studio lights. These comprehensive controls permit the user to view the simulation in studio lighting conditions, as well as to make revisions in color, paint type, and materials.

With real lights, direction and concentration are produced by reflectors, lenses, and housings. It would be possible to model these components directly, but that would introduce considerable overhead to the lighting computation. Instead of modeling individual causes, Autocolor models the overall effect, reducing complexity by simulating those aspects needed to produce realistic results.

Autocolor approximates the geometric shape of an object with a mesh of three or four-sided polygons. These polygons are grouped to form parts. For a car body, there might be separate parts for the door, hood, roof, fender, and so on. Each part is assigned a surface type, such as painted metal or glass, and each type of surface has associated color and reflectance properties. The entire data structure is stored in tables using an interactive relational data base developed at the GM Research Laboratories.

THE LIGHTING model determines the intensity of the reflected light that reaches the eye from a given point on the object. It takes into account the reflectance properties of the surface as well as the physics of light reflection. A hidden surface algorithm determines which point on the object is visible at each point on the display. For each of these visible points, the intensity is computed for each light source. The displayed intensity is the sum of the contributions from all the lights plus an ambient term which indicates the general level of illumination.

Using the point source lights of conventional image generation systems, highlighting a particular area of an object can be a difficult task and can result in unwanted highlights in other areas. By contrast, the light direction and concentration controls found in Autocolor make it possible to isolate the effect of a light to a particular area, and achieve a desired highlight easily and quickly (see Figure 2). This is not because Autocolor's lighting model computations are faster, but because its controlled "lights" behave in a more natural way.

Another unique feature of Autocolor is the ability to portray realistically a variety of different materials and lighting conditions. The color seen from a surface is really a combination of two colors: the color of the surface or material itself (diffuse reflection) and the color of the reflected highlights (specular reflection). The highlight color may be the color of the material, the color of the light, or a color derived from the material and the light.

A different highlight color can be used for each different surface type that is defined. This makes it possible to simulate materials such as plastic, painted metal, and chrome—each of which has different reflectance properties and requires a different highlight color.

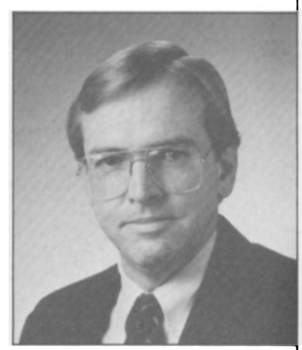
The user can interactively adjust the blending of the surface and highlight colors, watching the image change dynamically on the screen until a desired effect is achieved.

"Autocolor will free designers to be more creative," says researcher Warn. "Our goal is to move from controls that show changes in lighting, color, and materials, to software that will let the user change the actual shape, manipulating the image on the screen like a flexible clay model."

General Motors

GM
MARK OF EXCELLENCE

THE MAN BEHIND THE WORK

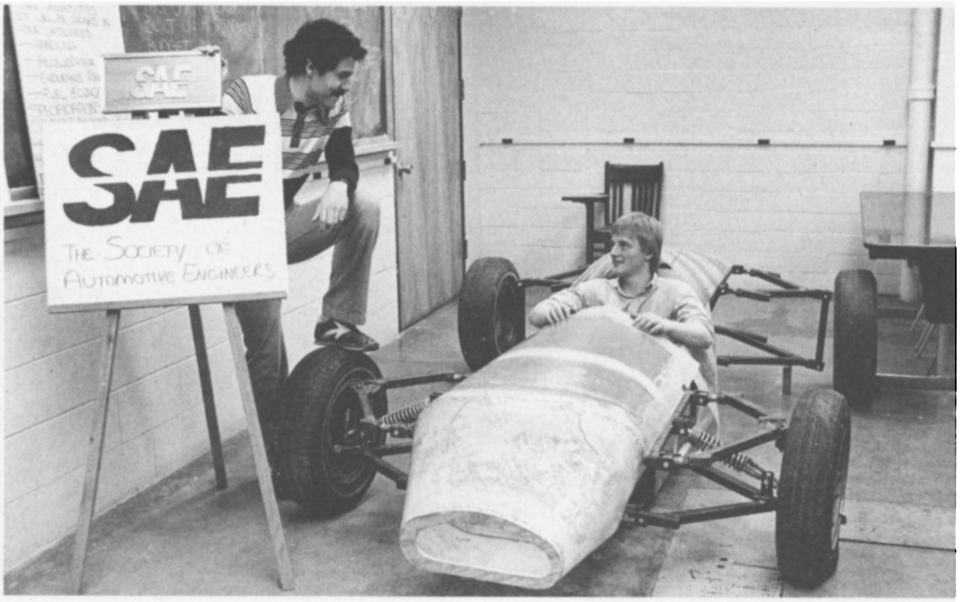


David Warn is a Senior Staff Research Scientist in the Computer Science Department at the General Motors Research Laboratories.

He received his undergraduate degree in mathematics from Carnegie-Mellon University, and his M.S. in computer science from Purdue.

He has done extensive research in relational data management systems with special emphasis on user interfaces and human factors. He also designed the prototype for the network data manager used in the GM Corporate Graphic System. His previous work on other aspects of computer-aided design include system design, file management, and simulation models.

His foremost research interests are in color synthetic image generation and interactive surface design. He joined General Motors in 1968.



The Formula SAE race car being built by UMC students is nearing completion.

Texas or Bust

by Richard Anderson and Jamie Gifford

Building race cars is usually not a project engineering students undertake, but the Society of Automotive Engineers—UMC Student Branch is doing just that. This race car is entirely student designed and built for participation in Formula SAE at the end of the semester. Formula SAE is an annual student design competition to be held at the University of Texas at Arlington on May 30-June 1, 1985. This year's event is sponsored by the Society of Automotive Engineers, the Sports Car Club of America, and the University of Texas at Arlington.

The rules require a student organization to design and build a mini-formula type race car, within certain specifications, and then compete against other student built cars. The cars are subjected to acceleration, skid-pad, maneuverability, and fuel economy tests and are judged on asthetic and engineering design, cost, and the oral presentations given by team members. In addition to the tests, there is an endurance race with every team competing at once, just like a Formula One Gran Prix.

Development of UMC's car began over one year ago with preliminary design work and a search for sponsorship. Sponsors include: Ed Gaebler of Central Columbia Association, Westlake's Ace Hardware, Sorrels Used Auto Parts, and Good Trails, Inc. Westlake's is providing body materials; Sorrels has given tires, wheels, and other major components; and Good Trails donated the engine. It is important to note that Dean Kimel has provided an immeasurable amount of support to this project and was instrumental in lining up sponsorship.

UMC's car consists of a fifteen gage, one inch square mild steel, tubular space-frame with a fiber glass body. Other notable features include four-wheel independent suspension, thirteen inch aluminum wheels, disc brakes, and rack and pinion steering. The engine is a 400 cc single cylinder Suzuki with a five speed manual transmission that acts through chain drive to a live rear axle. The car is 117 inches long with a seventy-three inch wheel base and sixty-five inch track.

Because of cost considerations and welding ease, the space frame and suspension A-arms are made of mild steel as specified by designer Scott Yerganian. Aluminum was too expensive and proper welding facilities were not available to SAE. The suspension is fully adjustable for caster, camber, and toe-in, and is designed so that, even during hard cornering, the tire is always verticle to the ground.

Dan Clark, SAE's "motorhead", is "heading up" modification and reconditioning of the 400 cc engine. Formula SAE rules require a twenty-three millimeter intake restriction which has given SAE the opportunity to develop a tuned intake runner for the engine. SAE is also considering the use of a supercharger for added power. Dr. F. Dee Harris, of UMC Agricultural Engineering, arranged for the use of a dynamometer to test the engine's power output.

Component and machine part design is largely the responsibility of John Kline while the car's body was designed by Richard Anderson. Fiberglass sheet with metal reinforcement is used for the body panels because it is easy to work with.

The Society of Automotive Engineers is open to all engineering students and would welcome anyone who is interested. SAE provides an excellent opportunity for hands-on engineering experience and professional development.

Part II ABET—What is Accreditation All About?

by William R. Kimel and Cyrus O. Harbourt

Engineering and technical education is offered at many levels in the U.S. and foreign countries including technician training in proprietary schools, company training programs, correspondence study and degree programs, 2 and 4 year technology programs (some certified by ICET), non-accredited 4 year B.S. programs in engineering, and ABET accredited engineering programs. There are even companies which offer engineering and technology degrees by mail under decidedly questionable conditions. As one might imagine, the quality of these programs varies widely among and within the various categories mentioned. There is a pressing need for a reliable, fair, and consistent way to ensure adequate uniformity and quality in the preparation of engineering registration candidates.

The Accreditation Board for Engineering and Technology (ABET), formerly the Engineers Council for Professional Development (ECPD), is the recognized accreditation agency for evaluating the quality of engineering and technology programs for professional and statutory law purposes in the United States. The most recent published data show the following numbers of accredited programs:

ABET Accredited Engineering Programs

1252 basic level (usually B.S.)
62 advanced level (usually M.S.)

ABET Accredited Technology Programs

457 associate level (usually 2-year)
267 bachelors level (usually 4-year)

ABET's accreditation programs are the most comprehensive and, beyond any doubt, the most thorough available means of evaluating the quality of U.S. engineering and technology education.

It is appropriate to consider the ABET accreditation policies and procedures at this point. First of all, ABET uses the following definitions:

ENGINEERING: Engineering is the profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize, economically the materials and forces of nature for the benefit of mankind.

ENGINEERING TECHNOLOGY: Engineering Technology is that part of the technological field which requires the application of scientific and engineering knowledge and methods combined with technical skills in support of engineering activities; it lies in the occupational spectrum between the craftsman and the engineer at the end of the spectrum closest to the engineer.

The content criteria applied to evaluate curricula in engineering and technology are briefly summarized below:

Engineering
(basic level)

Two and one-half years of mathematics, science, and engineering including one-half year of mathematics beyond trigonometry, one-half year of basic science, one year of engineering science, and at least one-half year of engineering design.

One-half year (minimum) of humanities and social sciences.

Engineering Technology
(bachelor's level)

124 semester credit hours (min.) including:

48 hours technical courses
24 hours basic science and mathematics
(12 minimum in mathematics)
24 hours social sciences humanities and communications
(9 minimum in communications)

I shall spare you more detailed discussion of criteria and content, except to refer to the **design** content criteria, which define a principal difference between engineering and technology.

Engineering design (one-half year minimum) is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and engineering sciences are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the design process are the establishment of objectives and criteria, synthesis, analysis, construction, testing, and evaluation. Central to the process are the essential and complementary roles of synthesis and analysis. The engineering design component of a curriculum should include some of the following features: development of student creativity, use of open-ended problems, formation of design problem statements and specifications, consideration of alternative solutions, feasibility considerations, and detailed system descriptions. It is also desirable to include a variety of realistic con-

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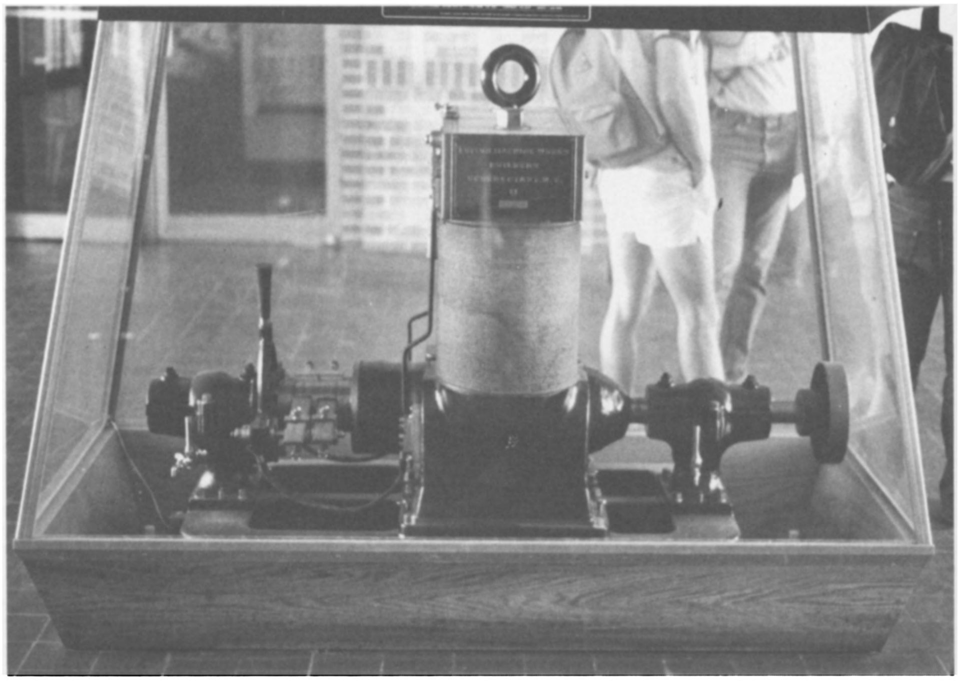
The First Department of Electrical Engineering

One hundred years ago, when the telephone was but four years old, and electric light was an unknown entity to most of the country, the first Department of Electrical Engineering in the country was established at the University of Missouri, Columbia. Or was it the first?

Since history was obviously not as formally recorded a century ago as it is today, it isn't exactly certain where the first electrical engineering department was established.

John D. Ryder states in *IEEE PRESS*, 1984, that the "first Department of Electrical Engineering was established at the University of Missouri, Columbia." However, most reports of that era cite Massachusetts Institute of Technology being the first in 1882.



The original dynamo Thomas Edison presented to the university in 1880 is displayed in the lobby of Electrical Engineering.

Regardless of the bragging rights as to which was first, literature of the times definitely shows that Mizzou has offered courses in electrical applications since 1880.

The University officially celebrates its departmental origin in 1885, making this the official centennial year of Electrical Engineering education.

The reasons for such early developments in the midwest were documented by Missouri professor of Electrical Engineering, the late Mendell P. Weinbach, in 1941.

Responsibility of such early developments rested on the shoulders of two men—Professor of Physics Benjaman E. Thomas and University President Samuel Spahr Laws.

Professor Thomas was the first who taught the practical applications of electricity known at the time such as telegraphy, primary batteries and signalling.

Thomas was an outgoing individual who made efforts in the early 1880's to get an appropriation for the purchase of the newly developed Edison dynamo and Edison Lamps to be studied by his students. This was at a time when any significant display of electric lighting had yet to be seen. Therefore, acquisition of such equipment was difficult.

Luckily for the University, President Laws happened to be personal friends with Thomas Edison himself, and through President Laws, Edison presented to the University a dynamo generator of his manufacture and some incandescent lamps.

The two had become friends years earlier when Laws was vice president of the New York Gold Exchange. Edison, only twenty-one years old at the time, was in New York waiting for a job as a telegraph operator with Western Union. He happened to be visiting the Exchange when a device that transmitted the quotations on gold failed to operate. The brokers failed to get the watched for quotations and a near panic was on. It didn't take very long for the keenly observant Edison to discover and point out to Laws the cause of the failure of the device. At Laws' request, Edison made the necessary repairs and was promptly hired at a very substantial salary to supervise the operation of the so-called "Laws Gold Reporting Telegraph."

Years later when Edison's notoriety became much more than that of Laws, the desired equipment from Edison was received by the University, and professor Thomas acquired a steam engine to drive the cherished dynamo. The complete equipment was set up by him and his students in the basement of the old Academic Building—where the University columns stand today.

In 1883, professor Thomas gave a public exhibition of incandescent electric lighting which was very likely the first such display west of the Mississippi river.

In 1884, enrollment in physics more than doubled. Experimental studies were now made in electrical measurements, in peformance of dynamos and of complete lighting plants.

To meet the growing demand for competent individuals with scientific education in this rapidly growing area, Professor Thomas recommended that a department of Electrical Engineering be established. Exactly one hundred years ago.

The department continued to grow into a respectable course of study. A 1905 university catalogue summarized additional Electrical course goals like so: "The course in Electrical Engineering is intended to prepare students for electrical designing, manufacturing, contracting and for the installation and management of light and power stations."

Today, the Electrical Engineering school is one of the largest departments on campus, and easily the largest Engineering department on campus.

Throughout the 1985 Engineer's Week, praise was often given by speakers of the development of Electrical Engineering studies over the last century, including this year's Croft Lecturer John Slaughter, whose theme was "Centennials: Making the Connections."

Indeed, the department and curriculum have come a long way since the days when Professor Thomas taught all three Physics courses that applied to electrical engineers in 1880. Today, the very Edison dynamo that Thomas acquired which provided advanced education and student enthusiasm toward technical education, sits in a glass case in the Electrical Engineering building as a token of the past and a model of continued excellence and advancement in the future.

The three story Electrical Engineering Building was opened in 1960 as a functional addition to the College of Engineering.

The Unknown Engineer

by Lawrence Turpin

Cloaked in the shadow of the Engineering Complex is a diminutive department called Agricultural Engineering. The department is based in three small buildings between Hatch Hall and the College of Veterinary Medicine. The most famous of these buildings is T-12, a "temporary" building erected during World War II. This building's lab and classroom space serves as the department's main center of educational guidance.

The duties of the Agricultural Engineering Department are divided between two colleges: the College of Engineering and the College of Agriculture. The department handles this responsibility by providing technical instruction for engineering students and "hands on" training for agriculture students.

The department's faculty and staff are headed by Dr. Neil Meador, a man sincerely interested in seeing the students obtain a job as well as a good education. The Ag. Engineering faculty and staff not only provide educational instruction, but they must also interface with USDA and Soil Conservation Service employees in developing technology to serve the profession of Agriculture. Among all the engineering disciplines, the Agricultural Engineering faculty has the highest percentage of Professional Engineers.

It seems many people are not aware that Agricultural Engineering is a true engineering discipline. Ag E's are required to complete the same mathematics and physics sequences as all other engineers. In addition, they must take several of the Civil-Mechanical Engineering courses such as Dynamics and Fluid Mechanics.

The classes offered within the Ag. Engineering department are designed to acquaint students with a broad range of engineering knowledge. Courses include farm electrification, power and machinery, soil and water conservation, farm structures, irrigation, waste management and crop processing. These courses incorporate basic engineering practices to applied areas in agriculture.

Research within the department has paved the way for much of the alternate energy technology of today. Two of the most notable research projects in recent years are the "New Technology House" and the "Energy Farm." The "New Technology House" utilizes a solar heating system and a high grade insulation fiber to provide an amazingly energy efficient home.

The "Energy Farm" is an integrated farm energy system which converts animal manure into methane gas via an anaerobic digester. An internal combustion engine, fueled by the methane gas, coupled with an electrical generator produces thermal and electrical energy. The system also includes an ethanol plant which uses a small amount of the thermal and electrical energy to convert corn into ethanol.

The faculty and staff are also researching areas involved with soil and water conservation, food processing and power and machinery. A fairly new area of research is developing called bioengineering, which combines engineering concepts with the development of improved genetic characteristics in plant and animal. As biological knowledge is increased, it will be necessary for engineers to develop the equipment used to implement the technology.

The future of agricultural engineering is a promising one. In the past, the farm machinery industry has provided most of the jobs for agricultural engineering graduates. A new addition to the job market are food and feed processing companies which are looking for engineers with agricultural training to manage and operate their plants. Other employment opportunities exist in research through university and government agencies.

Agriculture is much more than farming and the percentage of agriculture controlled by farming is becoming less with each passing day. The agriculture industry is much more involved with the inputs and outputs of farming than the actual act of farming. These inputs and outputs include the fertilizer industry, seed companies, machinery companies and the food processing industry. These areas combine to make agriculture the largest industry in the world.

The world cannot survive without agriculture and increased engineering technology will be necessary to keep the United States food machine running efficiently. This fact provides the need for Agricultural Engineering to remain a vibrant part of the College of Engineering.

The Shack

An Institution May Soon Be Gone

by Adam Bear

Sixty four years ago, Chandler Davis drove his truck from San Diego, California to Columbia, Missouri. He parked it in a lot at 704 Conley, and it hasn't moved since. That truck would become The Shack, today a landmark containing as much history as the Smithsonian; a landmark that may soon disappear.

Davis started selling sandwiches out of his truck in 1921. The "Davis Tea Garden", as it was called at the time, grew quite rapidly. The menu was expanded to include spaghetti, steak, and a very popular egg foo yong. Davis soon built on to house the growing crowds and a ten piece band that played every afternoon and evening. Lines of people stretched down Conley from Gentry to Maryland, waiting to dine at the table cloth covered tables. The classy establishment required diners to dress up; they couldn't wear hats, and the women couldn't smoke.

Well, the classiness eventually faded out; Davis died, and a man named Jack Armel bought the place in 1932. It slowly developed into more of a "beer joint"; the table cloths disappeared, and the University students began carving initials in the tables and walls. The carving caught on and lasted for fifty years.

Notable high points in that fifty years include a period of frequent visits to The Shack by Mort Walker, the famous cartoonist. As student editor of a campus magazine in the mid forties, he held meetings there weekly. Walker spent a good part of his college years in The Shack; his memories of the place have shown up several times since in his Beetle Bailey comic strip.

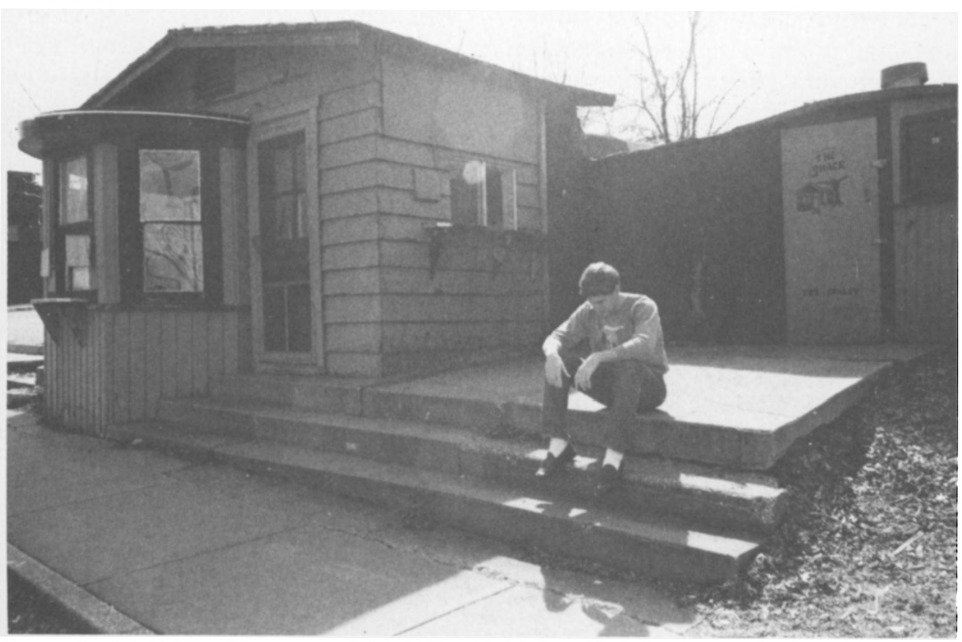
The Shack has also been honored in song. Jim Lowe, another Mizzou alumnus, wrote "Green Door" based on his feelings about The Shack, which became a fairly big hit in the fifties. Lowe went on to become a major New York radio personality; the song quickly died out, except from The Shack's juke box.

The Shack closed down in the late sixties, but was reopened in 1974. Its success was fairly limited, however, until a couple years later when Butch Weston, the most recent proprietor, took over. Butch and his wife, Donna, enjoyed several profitable years of business. The small building was filled to its 85 person capacity most every night of the week.

With the eighties, though, came not only an increased threat of nuclear war, dioxin, and AIDS, but something that would affect the human race to an even greater extent. The Shack's business began to dwindle. Employees were laid off. The Westons were suddenly making too little to even cover their costs. Finally, on May 19, 1984, Donna locked the green door, possibly to never be opened again.

It's been close to a year since a beer was drank in The Shack, since its juke box played a country tune, since the crack of the pool balls were heard. Peaking in the dirty window, one can still see the 64 year old skeleton of Chandler Davis' original truck. Will the door be opened again? No one really knows. The owner of the property, Joe Franke, was asked; "I really don't know what will happen; only time will tell."

Thousands of students and alumni are grieving the possible loss of the memory filled hole in the wall. Greg Olwig, a senior who frequented The Shack in his earlier years said, "Losing The Shack is like losing a friend . . . a best friend."



The author mourns the loss of the more than half century old institution.

continued from page 11

straints such as economic factors, safety, reliability, aesthetics, ethics, and social impact. Courses that include engineering design may be included at all levels of the engineering program. However, the major portion of the design requirement is to be satisfied by courses which depend upon mathematics, basic sciences and engineering sciences. Accredited engineering technology programs, by contrast, are expected to include an unspecified amount of **technical design** course work in "practice-oriented standard design applied to work in the field—such as construction—in which students acquire experience in carrying out established design procedures in their own areas of specialization. The key to this type of technical design lies in the fact that the courses would follow established design concepts developed by engineering and that there would be prime emphasis on standard design procedures and practices. Many of these design methods have already been included in handbooks or standard computer methods for various branches of engineering. These courses would require an understanding of the application of mathematics and science, for example to such activities as air conditioning systems design, duct design, piping design, amplifier design, computer component and circuit design, plant layout, materials handling operations and/or civil engineering technology applications such as road design.

Why is ABET the appropriate body to evaluate the educational quality of technical and engineering programs? ABET is a federation of 21 engineering societies and their interest and desire to foster professional standards and ethics among their members to ensure the quality of the engineering services they render. It also represents the interests of persons engaged in engineering technology activities who have similar desires, although the criteria and the evaluation committees within ABET are separate and distinct for both **engineering** and **engineering technology.** By its very nature ABET represents the entire engineering community and its stated primary purpose is to administer the accreditation processes for engineering programs and certification programs for technology programs. The working committees of ABET are made up of selected members drawn from the founder societies who have special knowledge of the accreditation and certification processes and who represent various fields of engineering practice including construction, consulting, industry, government and education.

The ABET accreditation process includes much more than consideration of curriculum requirements. Programs seeking accreditation are evaluated against a comprehensive set of criteria which establish the minimum standards for accreditation. Program and institutional characteristics are measured against these criteria in a highly objective and measurable manner.

There are several steps in the ABET accreditation process. The first step is for the institution to formally request an accreditation visit. Accreditation is a voluntary process at the option of the institution. After dates for the official accreditation visit are negotiated between ABET and the institution, the institution is asked to prepare and submit to ABET formal documentation of a comprehensive self evaluation covering program and institutional characteristics which relate to the accreditation criteria. After the accreditation team members have been selected and the self evaluation documents submitted, final details and a schedule for the team visit are agreed upon. The team visit is of 2½ to 3 days duration during which a formal agenda is followed. Students, faculty and administrators are interviewed and presentations are made by the dean and department chairmen followed by question and answer sessions. The purpose is to clarify information provided in the self evaluation documents, to further assess the competency of the faculty, to judge the quality of student work, to assess student and faculty morale and to make other judgments as they relate to accreditation criteria. At the end of the visit, the visiting team meets with the dean of engineering and institutional administrators in an exit interview at which general observations are reported by the team members without stating what their final recommendation may be regarding accreditation. Final determination and notification by ABET regarding accreditation of individual programs is made about one year after the visit during which time each university is permitted to respond to a preliminary report as a part of "due process."

It is quite clear that the criteria for engineering accreditation are exacting and that many technical and engineering programs may fail to satisfy these criteria. Nevertheless it is only through a process of this kind that the quality level of engineering degree programs can be assessed thoroughly enough for registration law purposes.

My personal judgment after many years of experience with the registration law of Missouri and the ABET accreditation process is that their relationship at present is a reasonable and satisfactory one. ABET engineering accreditation should continue to be the primary means used by the Missouri Board of Registration to determine the adequacy of the educational background of candidates for licensure. It is probably a social and political necessity to provide for some alternative path, under appropriate Board responsibility and control. Missouri's present law and its implementation using expert consultants seems to me a practical solution to the "alternative" problem. We have experimented with total elimination of alternatives and found it unacceptable in practice.

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