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wisconsin engineer

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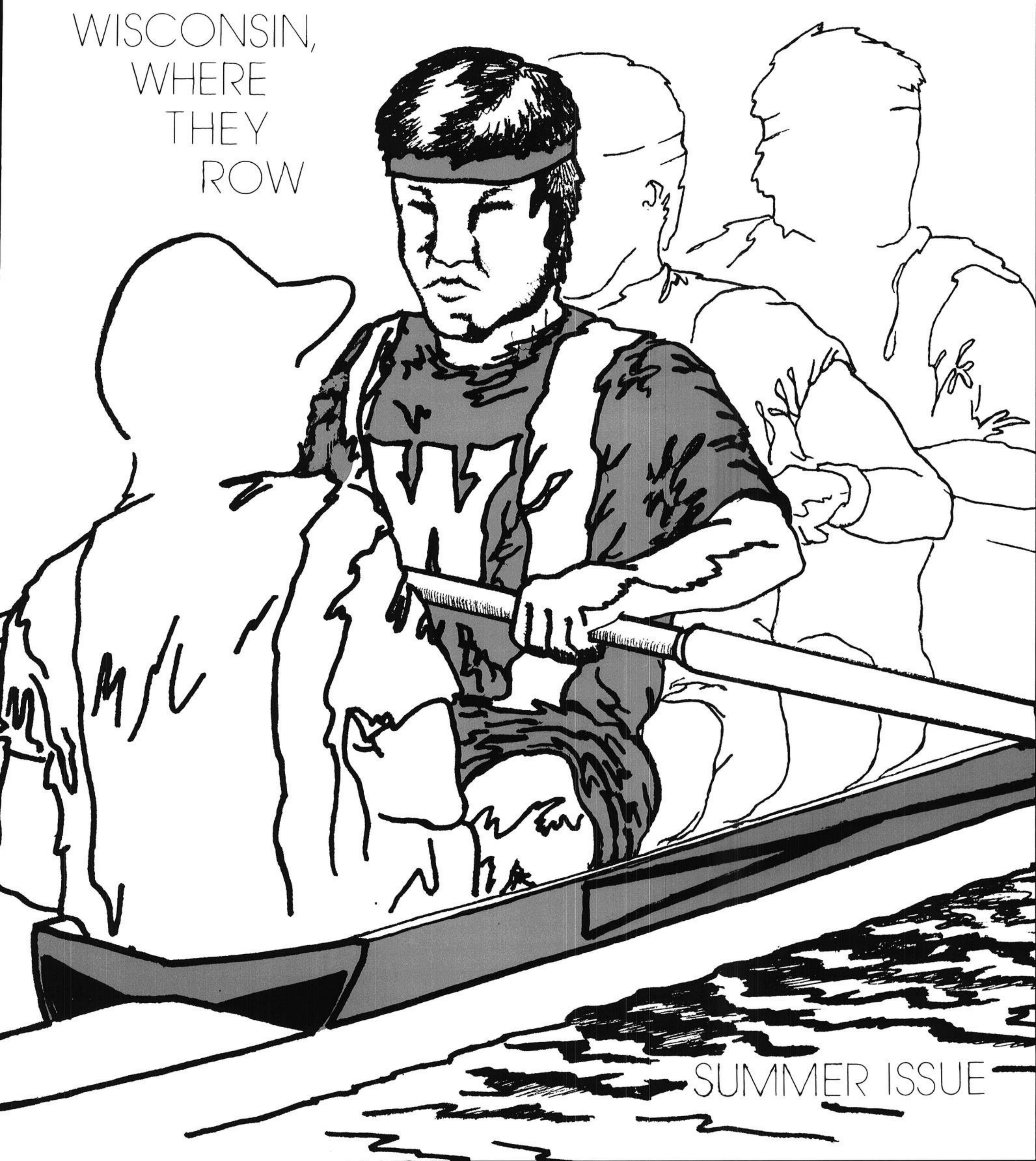

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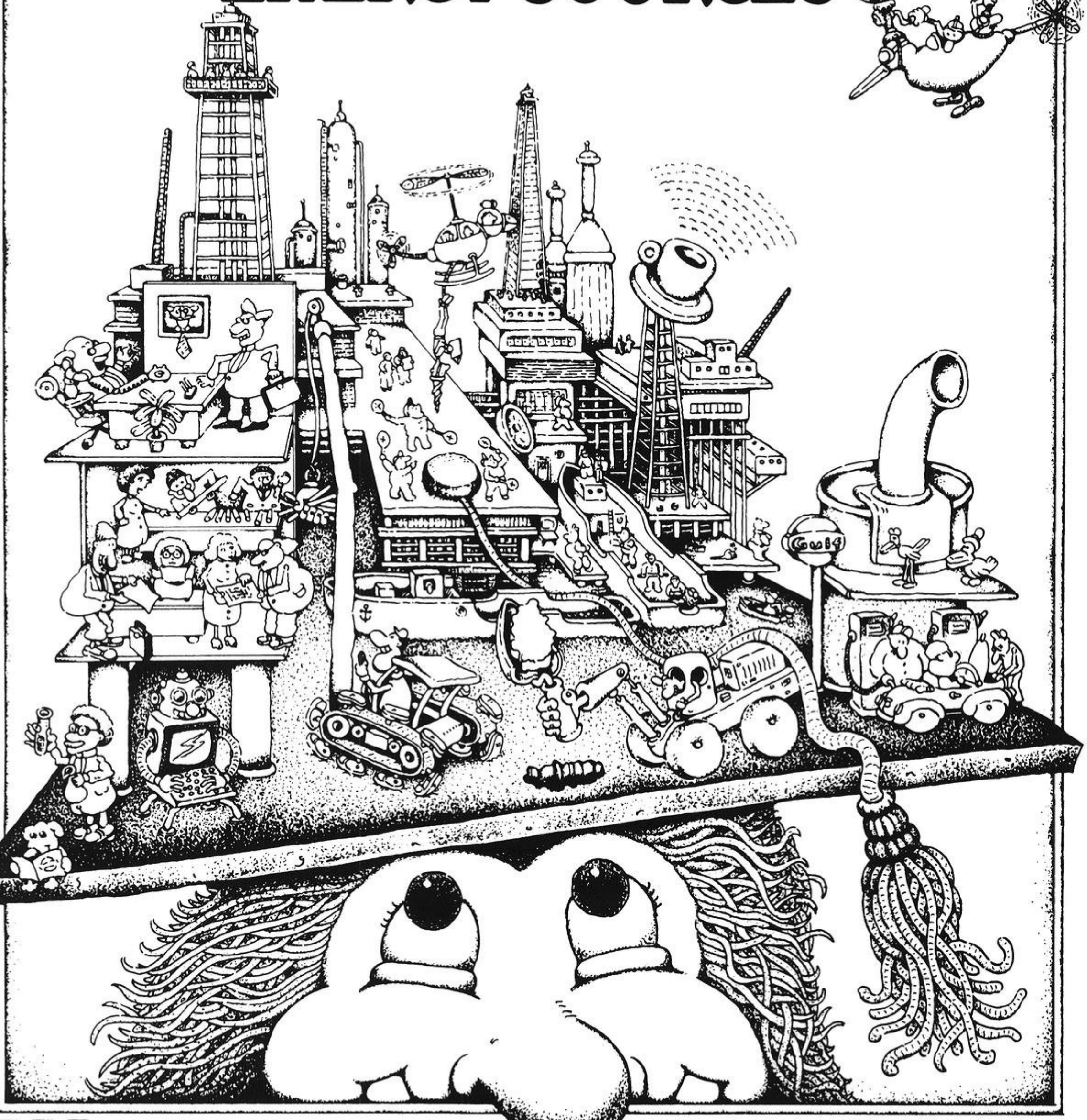

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wisconsin engineer

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COLUMNS

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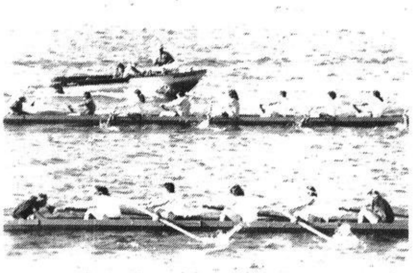
FEATURES



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About the cover: *In an old college ballad, our university was described as "Wisconsin where they row!", recognizing our crew teams' strong tradition. On our cover, Mark "Rock" Michelson has captured the big red rowing on Lake Mendota.*

Editorial

Is the engineer who designs a manufacturing robot responsible to the worker the machine will replace? Is the engineer who makes his/her living by designing computer systems for missiles jointly responsible for the arms build-up? And does the engineer share the guilt of his/her employer if the company is polluting the environment? These are important issues that remain unpondered by the engineering student who has a calculus and fluids exam next week. With our curriculum, we have too little time to take courses which would help us examine these aspects of our profession.

We receive lessons in combining numbers and properties, but none about how society functions, or how technology affects it. Sometimes, professors do relate course material to the "outside world," but usually these lectures are superficial and are presented on the first or last days of class when student reception is at its low-point. Thus, the engineer can graduate with a social perspective limited to numerical relations and solutions.

Students are hearing a great deal about the wonders of CAD/CAM and the new industrial revolution created by automization. Robots and computers will surely benefit us as consumers by producing material goods at much lower costs; but how will automization affect us as people? Will we begin to feel threatened by machines assuming greater responsibilities in our culture? And what about the unskilled workers who lose their jobs to robots? Will the welfare system absorb the new unemployed, or will they lash out at the "technocrats" with crime? The engineer would be in a better position to consider and comprehend these potential problems if she/he had taken psychology, socio-economic and philosophy courses while in college.

These problems with our curriculum also plague the engineering community. Here in Madison, the engineering buildings are isolated on the southwest corner of campus. The engineering student is geographically separated and naturally feels set apart from the **other** UW students. After graduation, this isolation can continue, and it would seem natural that professionals might feel isolated and never consider the effects engineering projects might have on the rest of society.

Thus, for this "engineering problem," we are given two parameters. First, it is necessary for each student to take all the currently required engineering courses. Since these take at least four years to complete, we cannot expect to add any additional liberal arts credit requirements. Secondly, the engineering buildings are where they are, and no philosopher can change that.

The only answer is for students themselves to supplement their technical educations with outside reading and involvement in non-technical organizations. By reading books, newspapers and magazines, we can gain new perspectives of the world we are to design after graduation. We must make the most of our liberal arts credits (the few we actually have) and, with the support of fellow students and faculty, we must generate thought-provoking conversations in the engineering community. □

Letters to the editor are welcomed.

Outlook

So you want to be an Engineer! As you enroll in the College of Engineering at the University of Wisconsin-Madison, you are embarking on a journey which will involve hard work, dedication, and a commitment to the ideals that have been set forth by your predecessors. Along the way, you will be accumulating the professional knowledge and skills which you will be called upon to apply to the advancement and betterment of human welfare. To be sworn into the society of professional engineers, you will be asked:

"to give the utmost of performance;

to live and work according to the laws of man in the highest standards of professional conduct;

to place service before profit, the honor and standing of the profession before professional advantage, and the public welfare above all consideration."

The first leg of your journey, pre-Engineering, is very important to your future. You are beginning your studies at a point in history when the demand for engineering talent has been at a record high. Engineering enrollments across the country have risen to record numbers of students as a result of the opportunities created by our industrialized society. This is all part of the good news for those of you who have chosen to pursue Engineering.

The bad news, however, is that the resources of our College are limited. There is a shortage of faculty, of classrooms, of laboratory equipment, and of financial resources. The difficulties which have been emerging in recent years have been compounded by a slow economy and the resulting deficit in our state budget. Therefore, it is important that you, as a pre-engineer, recognize that you will be competing for an opportunity to continue your studies in one of the professional degree-granting departments of the College. The competition will be stiff, and the demands on your time will be great.

Admission to a degree program in Engineering is dependent on grade point and the space available to accommodate students at each of the various departments in the College. If you plan carefully and obtain the proper prerequisites, you may apply for admission to a degree program when you have completed 24 credits of study. If in the course of your studies, you earn 54 credits of study but do not achieve an admissible grade point, you will no longer be permitted to continue in the study of Engineering.

To help you succeed in this journey, you have a wealth of resources. You can call upon distinguished faculty, who are dedicated to teaching serious students. You will find faculty whose research is at the forefront of technology and whose professional contributions are known worldwide. You will find fellow students who are dedicated to scholarship and helping others succeed. There are active student organizations working for your professional growth and well-being. You will find excellent facilities giving you access to modern equipment and computers and an outstanding library. It is your responsibility to seek and effectively utilize these resources.

In welcoming our pre-Engineering freshmen to this campus, I wish you success and great personal satisfaction as your journey proceeds.

John G. Bollinger
Dean

Fear and Freshmen at Madison

by David Eiche

The first task of a freshman is to read all the pamphlets about engineering. Since most brochures expound on the great careers awaiting graduates, we had David Eiche write an article to help freshmen as freshmen. A sophomore, David is planning to study Mechanical Engineering.

A forlorn college freshman stands in the rain, muttering, "Two courses. Nine lousy credits. At this rate, I'll finish school in about eight years and shell out over $30,000 in the process. Maybe I should just go home."

That freshman was me. A few weeks from now, it could be you. A freshman engineer masters college in the same way a rat runs a maze - by trial and error. The error part of the process can be kept to a minimum with good advice and a little luck. Ultimately, experience is the best teacher.

Your first discovery as an engineering student at UW-Madison will probably be that you are not alone. There were over one thousand freshman in engineering last year, which caused many difficulties for students and faculty alike. Simply stated, the College of Engineering has a surplus of students and a shortage of funds. This is a problem not only here at Wisconsin but at engineering schools all over the country.

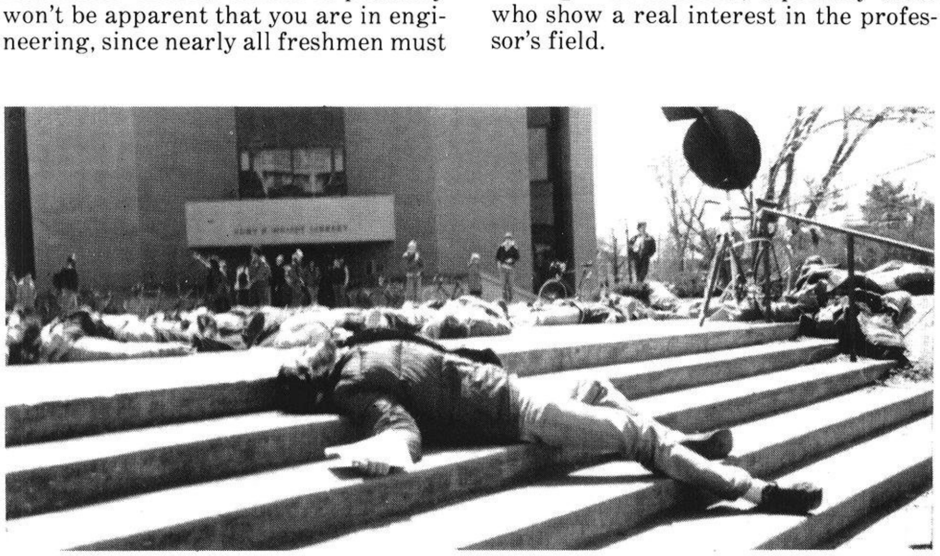
The overcrowding problem becomes painfully evident during the gauntlet every student must run - registration. UW-Madison's registration system is not exactly the last word in technology. The basic procedure is this: Every student receives a **Timetable** listing the courses available. Graduate students and upperclassmen register on the first days; freshmen chosen by the fickle finger of Fate to register early in the day will probably get the courses they need, but those registering later may not. "Registering" means being paraded through the Stock Pavilion like Elsie the Cow and then running around madly in search of the assignment committees scattered across campus. An assignment committee is a group of people beleaguered by students seeking the committee's stamp of approval on their registration forms. Collecting these stamps is the whole purpose of registration, since they reserve the "stampee" a place in a class. Through some unknown meteorological phenomenon, the probability of pouring rain on the freshman registration day is nearly 100%.

All too often, courses (especially engineering courses) fill up before Mr. or Ms. Unfortunate Freshman can enroll in them. The usual advice is to enroll in anything available (e.g., Chicken Plucking 101) while hoping for some other bewildered soul to drop out of a course one needs. Another piece of advice: don't be afraid to search out people to help you. Despite the crush of students, the advisers at the Freshman Office are eager to provide assistance. You must take the initiative, though; the advisers can't come looking for you.

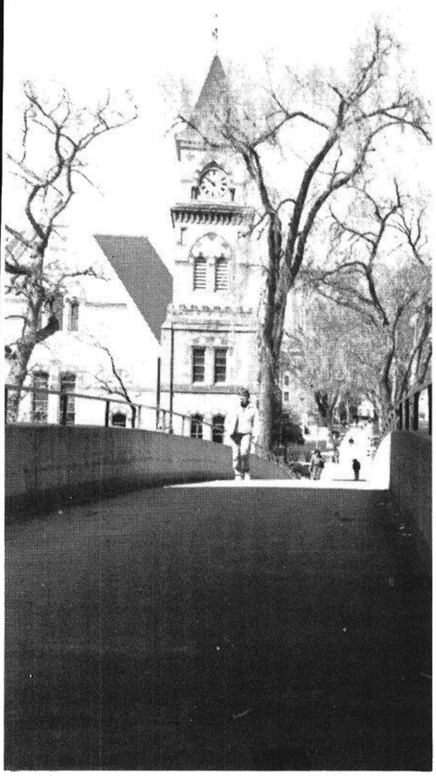
Let's assume you have survived Registration Week with your sanity and at least some courses intact. It probably won't be apparent that you are in engineering, since nearly all freshmen must take the fundamental courses before they can enroll in engineering subjects. The common denominator for engineering freshmen is calculus (no pun intended).

Calculus is an amazing course. For hundreds of years, the finest minds in the world tried unsuccessfully to compute the area under a curve; after a few weeks of study, you'll do the same thing for homework! That fact may encourage or discourage you. In any case, you should be able to master the subject if you are well prepared. Professors delight in posing unorthodox exam questions which test their students' true grasp of the material. Without thorough study, the tests seem more difficult than they actually are. The same can be said of most of the classes you will encounter.

Another common characteristic of most freshman math and science courses is the large lecture, typically consisting of more than 200 students. This tends to put a great deal of distance between the individual student and the professor. The way to break through the impersonal lecture system is to talk to the professor personally. Most professors enjoy talking with students, especially those who show a real interest in the professor's field.



Nuked at noon - engineering students "die-in" to protest the nuclear arms build-up.



Another helpful soul is the teaching assistant (TA). TA's are graduate students who conduct discussion sections in the large lecture classes, usually twice a week. The TA is somewhere between the professor and the student; he probably knows the course material as well as the professor, yet he's also a student.

Needless to say, there is more to college than academics. The atmosphere of Madison has quite a bit of influence on students. The city has a long tradition of liberalism (now generally referred to as "progressivism") and a good measure of craziness. In the State Street Mall area, it is not unusual to find chanting, bald-headed Hare Krisnas, fire-and-brimstone preachers, panhandlers, and determined political speakers mixed together with the professors and legions of students. Somehow, they all coexist peacefully-usually.

Madison's huge student population (over 40,000) and general permissiveness create a healthy social climate. Some new students plunge into a heavy social schedule, and their course work suffers as a result. Others are overwhelmed by it all and decide to ignore the parties and study like monks. The trick is to find the happy medium between these two extremes. It is probably better for you as a new freshman to be conservative, at least until you know how much time you will need for studying. It's possible to fall far behind in college without realizing it - until six-week exams, when a sickening sense of doom sets in.

One way of combining social activities with academics is to participate in the many professional and social organizations on campus, especially those which are engineering-oriented. These organizations offer an opportunity to meet people with a common interest, develop leadership and communication skills, and learn more about whatever branch of engineering you have chosen. A side benefit of membership is that prospective employers are impressed by people with activities outside of their regular classes.

Finally, don't be discouraged by UW-Madison's size, scheduling problems and academic pressure. If you take the initiative to talk to people and "wheel and deal" in the event of scheduling difficulties, you'll have solved the first two problems. As for academics, the best advice is to study the material well, use your common sense, and don't be obsessed by grades. As a new freshman, you have great challenges ahead of you, but the potential rewards are great also. Good luck. □

Wisconsin, Where They Row

by Bonnie Buhrow

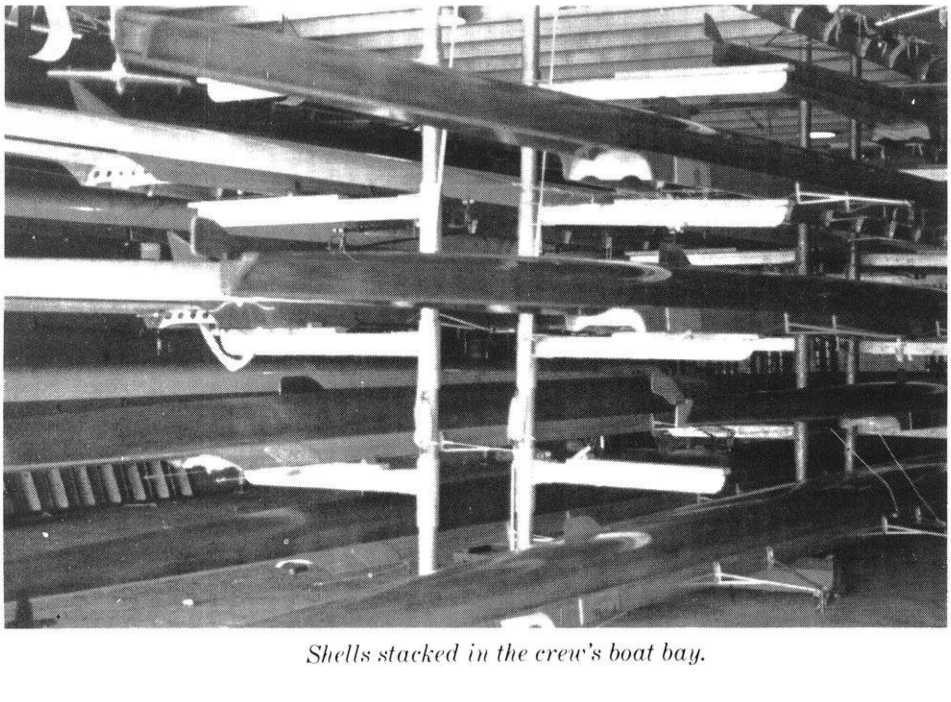
A crew team consists of nine members. Eight are rowers, and the ninth is the coxwain who is responsible for steering the boat and leading the team in competition. The shell used in races is a very light boat approximately 60 feet long and two feet wide.

The women's crew team glides by the Memorial Union.

You're lounging on the shores of Lake Mendota when a long, thin boat glides into view. It's a pretty sight, and at a distance, the craft's movements seem uncomplicated, effortless. But appearances can't deceive the man standing next to you, Randall Jablonic, head coach of the men's crew program - he sees all the "strain underneath that poetry."

Uncomplicated? On the contrary, rowing is an advanced course in applied math and physics. The simple act of pulling the oar out of the water is a complex engineering problem. This movement exerts a torque of more than 66 foot-pounds per rower about the longitudinal axis of the shell. Sixty foot pounds times eight oarsmen - that's a lot of disturbance for such a delicate boat.

Effortless? Coach Jablonic uses this analogy to illustrate the intense physical demands of the sport. "Eight golfers are teed up 200 yards from the hole, and they all simultaneously have to hit a hole-in-one. Not just once, but 200 times in a row. And, with each shot, each golfer is pulling 180 pounds." That's the kind of strength and precision each and every stroke of the oar requires for a team to compete successfuly.



Shells stacked in the crew's boat bay.

And the University of Wisconsin's crew teams historically have competed successfully. The men's crew's first championship was won in 1898. In the last 12 years, the men's varsity has picked up half a dozen national titles. The women's crew is also ranked among the country's best. Coach Jablonic attributes winning records in the 70's to several things: the ease of on-campus participation, the sport's tradition in Madison, and most importantly, the new crew facilities constructed in the late 60's.

The crew facilities include boat bays where the shells are stored, a study area, locker rooms, a shop for repairing damaged equipment, and, crucial in this ice-locked state, a "tank" for indoor rowing practice. The tank really resembles a large (approximately 40 foot square) swimming pool with a wide deck in the middle on which up to sixteen rowers can be seated. As an oarsperson practices his or her strokes in the aisles of water on either side of the deck, he or she can correct mistakes and improve technique thanks to two large mirrors attached to the opposite wall.

Besides tank practice, the winter training schedule includes weight training, running, and cross-country skiing. In the spring and fall, practice begins on the lake. Whatever the season, crew members work out several hours a day, six or seven days a week.

Even though the competition season is virtually limited to two months - April and May - and the races themselves last only six minutes, all this physical conditioning is necessary. During the events, rowers burn calories at the rate of 6000/hr., making crew one of the highest performance sports.

Unlike Badger hockey or football players, individual crew members on winning teams don't receive a lot of publicity or glory. So where does Coach Jablonic find all these gifted, self-denying athletes? "In registration lines." His scouts fan out in the fall, attempting to recruit promising physical specimens from the mass of incoming students. A potential championship crew member should be tall - at least 6'5" to 6'6" for men, and over 5'6" for women. Stature aside, a good oarsperson is usually strongly goal-oriented and an excellent team player. A background in high school sports helps, but isn't required. Crew teams past and present have been composed of all types of students - law, medical, engineering, liberal arts. Ironically, the only discipline that has been under-represented is physical education. The program's latest recruiting efforts might have been a little too successful. The present crew facilities were designed to accommodate a men's varsity of about 25 and a freshman team of 15-20. With the creation of a women's program and expansion of the men's, approximately 300 people now participate in the sport, and the design potential of the crew house has been exceeded by four times.

According to Coach Jablonic, training time has had to be cut below an optimum level due to the crowded facilities. And the men's varsity now has to practice at 6:00 A.M. - a time that doesn't easily fit into a Madison student's lifestyle. However, there's hope that financial support for the sport will be increased and a second tank built to better accommodate all potential crew members.

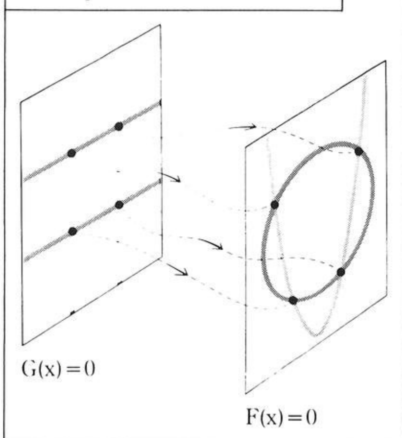
Participation in crew is probably growing because the sport's rewards can make all that hard work seem worthwhile. Joining any campus team will allow you to meet people, make friends, and feel more at home on campus. Being a member of the crew team can have benefits that last long after graduation. Because of the training regime rowers undertake, their cardio-vascular systems are better developed than those of athletes in almost any other sport. Recent studies have shown that this superior physical conditioning can increase a person's life span by up to ten years. For engineering students, crew membership has an added plus: each stroke a rower takes is an engineering problem to be solved, and these practical applications of mathematics and physics help the student to grasp scientific theory.

So if you're standing in line next August, and someone starts plugging crew membership to you - take the plunge. It will be worth it. □

The Continuation Method

The need to solve systems of polynomial equations arises in pursuits ranging from geometric optics to chemical kinetics. A practical method of solution, developed at the General Motors Research Laboratories, provides designers of mechanical parts with a new capability.

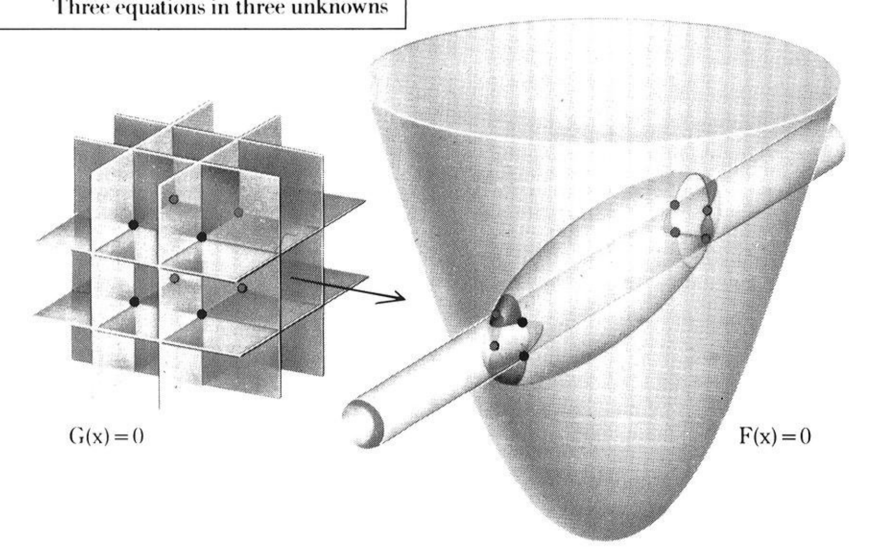
Two equations in two unknowns



The two pairs of parallel lines of G(x) = 0 evolve into the parabola and ellipse of F(x) = 0.

The three pairs of parallel planes of G(x) = 0 evolve into the paraboloid, ellipsoid and cylinder of F(x) = 0.

Three equations in three unknowns



CLASSICALLY difficult non-linear equations—those made up of polynomial expressions—can now be solved with reliability and speed. Recent advances in the mathematics of continuation methods at the General Motors Research Laboratories have practical implications for a wide range of scientific and engineering problems. The immediate application at General Motors is in mechanical design. The new method finds all eight solutions to three quadric equations in a few tenths of a second—fast enough for computer-aided design on a moment-to-moment basis. Algorithms based on this method are critical to the functioning of GMSOLID, an interactive design system which models the geometric characteristics of automotive parts.

Systems of non-linear equations have been solved for many years by "hit or miss" *local* methods. The method developed at General Motors by Dr. Alexander Morgan is distinguished by being *global* and *exhaustive*. Local methods depend on an initial estimate of the solution. They proceed by iterative modifications of this estimate to converge to a solution. However, success is not guaranteed, because there are generally no practical guidelines for making an initial choice that will ensure convergence. Reliability is further compromised when multiple solutions are sought.

Global methods, by contrast, do not require an initial estimate of the solution. The continuation method, as developed by Dr. Morgan, is not only global, but also exhaustive in that, assuming exact arithmetic, it guarantees convergence to all solutions. The convergence proof rests on principles from the area of mathematics called differential topology.

Here is the way continuation works. Suppose we want to solve a system $F(x) = 0$. We begin by generating a simpler system $G(x) = 0$ which we can both solve and continuously evolve into $F(x) = 0$. It is important that we select a G properly, so the process will converge. Dr. Morgan has devised a method for selecting G which gives rapid convergence and reliable computational behavior. He first applied a theorem established by Garcia and

Zangwill to select G. However, the resulting algorithm could not achieve the speed and computational reliability necessary for several applications. Next, he utilized some ideas from algebraic geometry—"homogenous coordinates" and "complex projective space"—to prove a new theorem for selecting G. The result of Dr. Morgan's efforts is a practical numerical method based on solid mathematical principles with innate reliability.

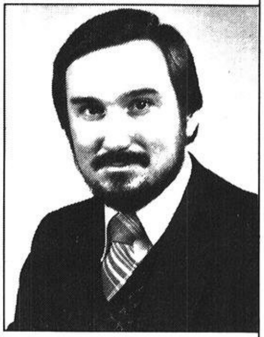
Reliability is the critical element for mathematical methods embedded in large computer programs, because errors may not become evident until after they have ruined a large data structure compiled at great expense and effort. Speed is also important to economical real-time implementation. This method has proved to be reliable and fast in solving problems involving equations up to the sixth degree in three or four variables. However, there are obvious practical limitations on the number of equations and their degree, due to the limited precision of computer arithmetic and computer resource availability.

THE FIGURES illustrate the transition from simple $G(x)=0$ to final $F(x)=0$. In both figures, the "simplicity" of $G(x)=0$ is reflected graphically in its linear structure—seen as lines and planes. The non-linearity of $F(x)=0$ is seen in the curvature of the final shapes in each figure.

In figure 1, the four dots on the left plane represent the set of simultaneous solutions to the system of equations $G(x)=0$. The four dots on the right plane represent the set of simultaneous solutions to the system of equations $F(x)=0$. The dashed lines represent simultaneous solutions to intermediate systems whose graphs would show the evolution from one configuration to the other. With the addition of a third dimension in figure 2, the number of dots representing simultaneous solutions doubles. Representation of the transitional points, as in figure 1, would require a fourth dimension.

"Continuation methods, although well known to mathematicians," says Dr. Morgan, "are not widely used in science and engineering. Acoustics, kinematics and non-linear circuit design are just a few fields that could benefit immediately. I expect to see much greater use of this mathematical tool in the future."

THE MAN BEHIND THE WORK



Dr. Alexander Morgan is a Senior Research Scientist in the Mathematics Department at the General Motors Research Laboratories.

Dr. Morgan received his graduate degrees from Yale University in the field of differential topology. His Ph.D. thesis concerned the geometry of differential manifolds. Prior to joining General Motors in 1978, he taught mathematics at the University of Miami in Florida and worked as an analyst at the Department of Energy's Savannah River Plant in South Carolina.

While serving in the U.S. Army, Dr. Morgan participated in the development and analysis of simulation models at the Strategy and Tactics Analysis Group in Bethesda, Maryland.

Dr. Morgan's current research interests include the qualitative theory of ordinary differential equations and the numerical solution of non-linear equations.

The Last Semester

by Betsy Priem
and Vandana Kulkarni

A great university is made up of great individuals. Writers Betsy Priem and Vandana Kulkarni found Professor George Sell to be one of those people who have helped make the UW what it is today. Vandana is a senior in Biochemistry and Betsy is a junior in Chemical Engineering as well as Associate Editor of the ***Wisconsin Engineer.***

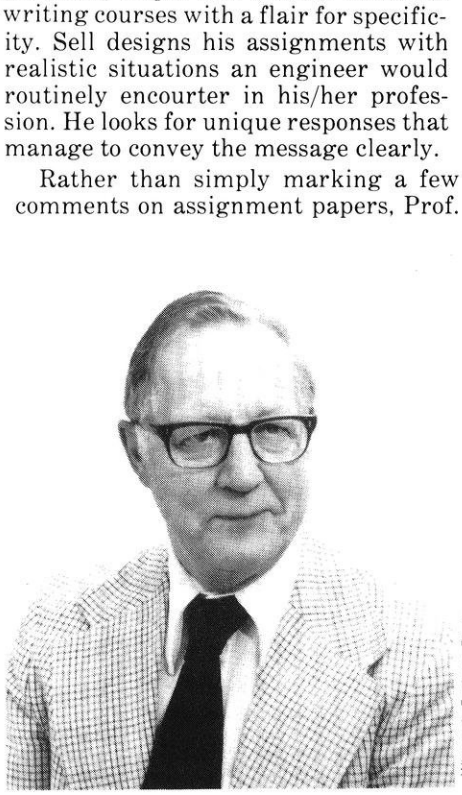
There are certain risks involved in granting individuals free reign to innovate. There are tremendous advantages as well. By allowing Professor George R. Sell the freedom to initiate changes, the College of Engineering has occasionally tread on unsure ground. The reward has been new programs designed specifically to meet the needs of students as individuals.

In response to students needs, Prof. Sell initiated a Cooperative Education Program 14 years ago. This option enables students to combine work experience with their education. Semesters of coursework are alternated with full-time employment. (See page 12.) The program gives students experience so they can verify their interests before completing their curriculum. Broad support throughout the College of Engineering helped the program to expand. Sell, the Director of the Co-op program, still upholds his founding maxim that a student must be matched with a compatible employer on a one-to-one basis.

A similar goal is set for graduate students in the Professional Development Program. Correspondence courses plus independent study and regular courses allow flexibility so that graduates can continue their studies while remaining in industry. This program of continuing education, for which Prof. Sell has been Director, is of great interest to industry.

As a professor in the Mechanical Engineering Dept., Sell teaches technical writing courses with a flair for specificity. Sell designs his assignments with realistic situations an engineer would routinely encourter in his/her profession. He looks for unique responses that manage to convey the message clearly.

Rather than simply marking a few comments on assignment papers, Prof. Sell Schedules individual conferences with each of his students to discuss their work. This close association helps him guide students in developing an individual writing style.



Wisconsin Engineer Photo

Professor George Sell.

If you ever wondered how the *Timetable* comes to exist, you may want to ask Prof. Sell. He's been juggling students, teachers, rooms and time slots for the past decade or more in order to come up with a schedule that works for everyone. Deciding how many sections are needed as well as when and where classes will meet is no small task, but "after you've been doing these things for so many years, it gets easier!" declares Sell. Another of his extended projects entails reorganizing the student counseling and records system. His work in this area has resulted in more consistent and complete student records.

Prof. Sell will retire in August after 28 years as a faculty member in the Department of Mechanical Engineering. He came to the College of Engineering in 1954 as a machine shop instructor. He was made an associate professor in 1959 and a full professor in 1967. He has served as Associate Department Chairman for 16 years and faculty advisor to the *Wisconsin Engineer* from 1950 to 1962. Prof. Sell also saw 4½ years of active service in WWII, and continues today as a retired Lieutenant Colonel in the Army Reserves. □

Yes, Virginia, There is Life After Graduation

by Laura Derocher

As students, we all wonder what it's going to be like as "real engineers." ***Wisconsin Engineer*** *writer Laura Derocher asked a professional about post-graduation life. Laura is a sophomore from Appleton, Wisconsin pursuing a Chemical Engineering degree.*

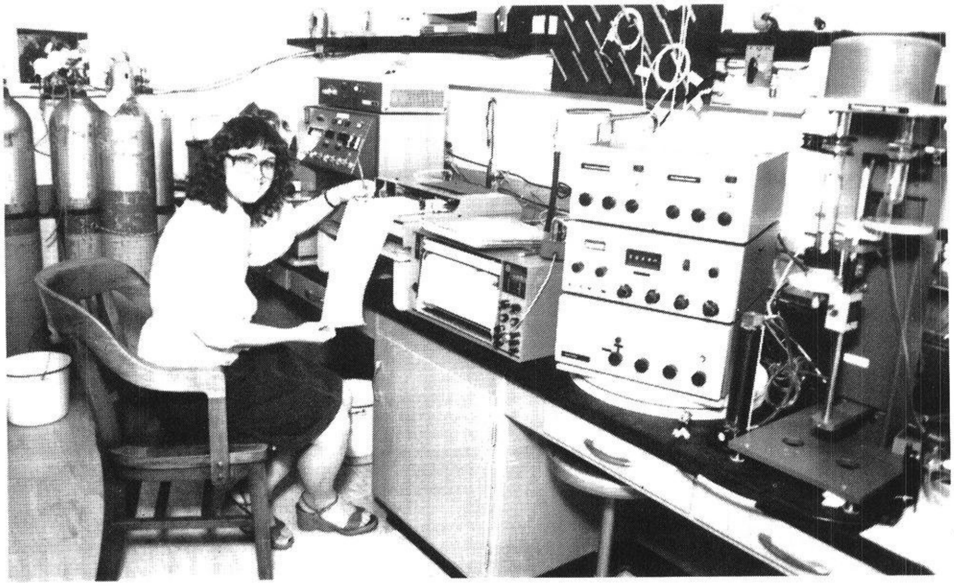
With each commencement, UW-Madison sends yet another set of highly trained engineers into the "real world." What is their destiny? Is there, in fact, life after graduation?

Yes! affirms Susan LeVan, who received her B.S. degree in chemical engineering from UW-Madison in December, 1980. Susan is presently employed as a research engineer at Forest Products Laboratory located here in Madison.

The Forst Products Laboratory (FPL), a division of the Department of Agriculture Forest Service, is devoted to improving the use of forest products in industry and manufacturing. Susan is part of a four-member research group studying the fire retardent treatment of wood. Although she works with a team, Susan says, "My projects are my own. I have to submit a study plan, formulate my ideas. If I had a supervisor, I would probably have less freedom than I do now. Now, I'm pretty much on my own, like, "Here, we'll do this." "Okay, go ahead and do it!"

Susan's job wasn't always as much under her control. Her first assignment upon arrival at FPL was to develop a mathematical model for smoldering combustion. She worked under a supervisor and found she was not really content researching just one project because delayed shipments and slow lab procedures left her with too much free time. Finally, when she let her supervisor know that she could handle more work, he assigned her more projects. "Initially, I was very bored. Now I haven't got enough time to do everything I have to do!"

Susan truly enjoys research. When asked if she would consider seeking a management position, she replied, "I like playing around with the instruments, turning knobs and figuring out problems. I think I'll stay in research. I like people a lot and I'd like managing, but I'd sure miss mucking around with the tools and equipment."



RMJ Photo

Sue Le Van: "I like playing around with the instruments, turning knobs, and figuring out problems."

Susan would like eventually to earn a Master's Degree either in chemical engineering or materials science. "I could go further; in research you almost have to have a Master's. Right now I'm not limited by lacking a graduate degree, but maybe sometime in the future I would be."

Although Susan's work is done mostly in the lab, her other duties include budgeting and presenting her analyses. "I have to submit a budget for the upcoming year, and that involves not just budget for research, but budget for any books that I need or planning for trips. You see, when I finish a project, I have to write it up and then I can either submit it to a journal, or submit it for an in-house paper, or I can present it at a conference. So I have to budget for those types of things, too."

Ye gads! Writing and public speaking are to the typical engineering student like liver and onions to a five-year-old. Does Susan feel that the rigorous, technical engineering curriculum required at UW prepared her for the interpersonal, communicative aspects of her work? She recalls her first oral presentation: "I was really nervous, getting up in front and presenting this paper. I felt that I was lacking in public speaking ability."

To compensate for this weakness, Susan joined the Toastmaster's Club, an organization designed to improve public speaking skills, which, she says, helped a great deal. As for her technical writing ability, Susan credits her high school English teachers for showing her how to write a good sentence, though "I feel I could have used some more writing courses." Susan does receive writing help at work, however; she can submit papers to the editorial staff at FPL for corrections and clarifications.

Susan interviewed at some larger companies (Chevron, IBM), but she enjoys the more personal atmosphere of a smaller place like FPL. "You get to know the people very well. You can have a lot of social contact and a lot of work contact. I feel that's very good. There's very much a feeling of community in the lab."

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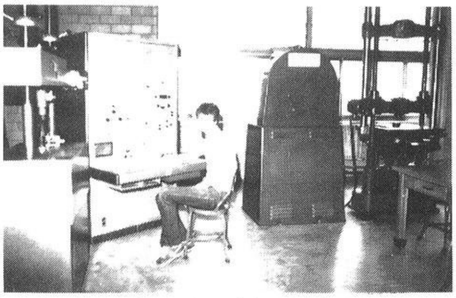
The Double Life of David Q.

by Mark Bartkowski

The engineering Cooperative Education Program is among our college's finest alternative education plans. Mark Bartkowski interviewed a "co-op" student to get a personal perspective of the program. Mark is a sophomore planning to study Mechanical Engineering.


RMJ Photo

Co-op student David Quebbemann.

For many students, summer break means pounding the pavement in search of a three-month job. But a few engineering students don't have to go through this often frustrating process. Their jobs are waiting for them.

These students are involved in the Cooperative Education Program. Designed especially for engineers, the co-op program is a "work-study" plan. The student attends school one semester and works at an engineering firm the next.

Co-op student Dave Quebbemann is spending this summer at Danley Machine Corp., a tool-and-die company that designs and manufactures stamping presses for the auto industry. Dave, who spent last spring semester in school, has already worked three semesters at Danley.

The reasons an engineer would want to co-op are pretty obvious. A lot of students don't know what the engineering world is all about. Co-oping gives first hand experience of what the student will be doing after graduation. As Dave puts it, "I was unsure of what engineering was, and I wanted to find out more about it and help define what I wanted for a future job. Also, there is the aspect of money to help pay for school." Dave said that if he didn't have to pay out-of-state tuition, he would be making enough money to pay his way through school.

With all of its advantages, the co-op program isn't for everyone. Some people don't want to spend five or more years in school. Another personal conflict is created by having to relocate to the host company's city for each work period; the student misses out on some of the social and leisure aspects of college. "These factors bothered me a bit," Dave said, but added that the positive side of co-oping far outweighed the negative.

A co-op student has access to every field of engineering, even some aspects of business or industry that aren't normally connected with engineering jobs. For

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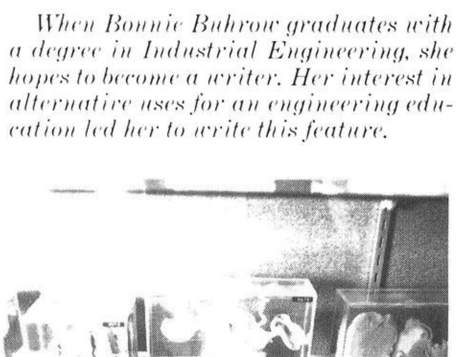
Engineering: A Good Pre-Med Major?

by Bonnie Buhrow

When Bonnie Buhrow graduates with a degree in Industrial Engineering, she hopes to become a writer. Her interest in alternative uses for an engineering education led her to write this feature.


RMJ Photo

Engineering students are good med school material.

Question: What do sutures and circuits have in common?

Answer: Kevin Weber, first year student at the University of Wisconsin Medical School, who graduated from Northwestern in 1981 with a degree in biomedical engineering.

When Kevin entered the engineering program at Northwestern, he didn't really intend to become a practicing engineer; his work experience at a medical clinic during high school had already convinced him to pursue a career in medicine. Most pre-med students, roughly 70%, major in natural sciences - zoology, biology, chemistry - at the undergraduate level. Why did Kevin opt for a bachelor's in engineering?

"I thought it was more practical to get an engineering degree in case I didn't get admitted to medical school," Kevin explains. "After all, if you don't get in, what can you do with a B.S. in biology? Not much." Since only 35%-45% of medical school applicants are admitted, alternative career preparation is a very good idea. Even if Kevin had been rejected by the UW Medical School, his biomedical engineering degree would offer him a career alternative at any one of many medical supply and equipment firms.

Kevin had another important reason for choosing engineering as his undergraduate major. "At first, I thought I'd like to go into medical research where an engineering background would be a big help. Now, though, I'm leaning more towards a specialization in surgery."

Did his rather unique pre-med training help Kevin get into medical school? He doesn't believe it really improved his chances. "It might have helped on the physics part of the MCAT, but that's about all."

The MCAT which Kevin alludes to is the Medical College Admission Test, a day-long ordeal undergone by every prospective UW medical student. This written

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Peace Corps: Engineers in Exotic Lands

by John Wengler

In researching this article, John Wengler read periodicals and Peace Corps literature, and consulted returning corps volunteers and the Peace Corps Recruiting Office in Ag Hall. John, a junior in Civil and Environmental Engineering, is the Editor of the ***Wisconsin Engineer.***

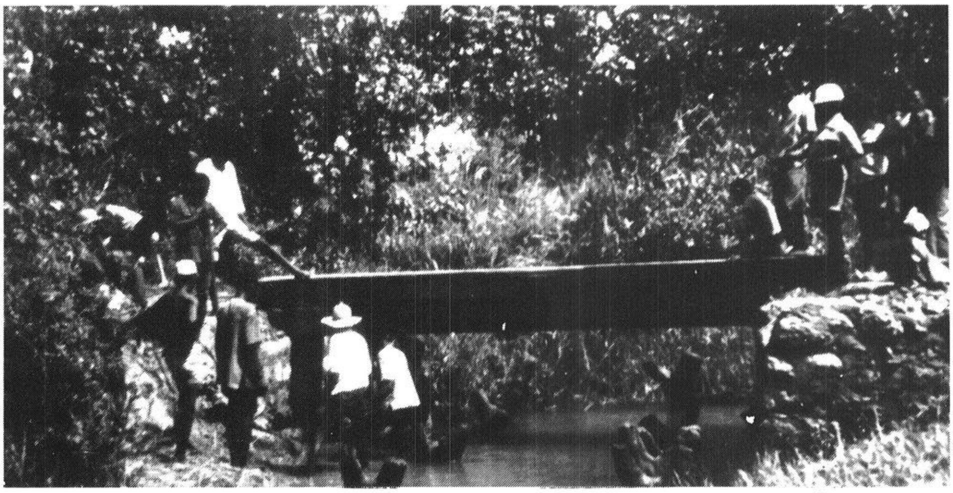
Photo by Jim Sumvalt

Peace Corps' programs involve the entire community. Besides earning wages, workers learn skills that can be employed during future construction projects.

A well-paying job and involvement within industry are the student's goal after many a painful semester at the UW. Many graduates are often unaware of an alternative post-college route that stimulates personal and professional development, and exceeds monetary value. As a Peace Corps Volunteer, the engineer has an opportunity to share the benefits of his education with people of developing nations. The Peace Corps (PC) helps nations of the Third World such as Napal, Upper Volta, and Ghara adjust to numerous changes which they encounter upon entering the modern age. Using his engineering skills, the volunteer may work in his host country to improve its productivity by laying a foundation of roadways, buildings, and small industries.

The economies of Third World countries remain weak (in modern terms) due to lack of technical expertise. The high cost of importing food and goods takes money from the national budgets, money that is sorely needed for internal development projects. Even more damaging is the loss of human energy (due to malnutrition) that drains the citizen's desire and ability to improve the standard of living. PC volunteers teach methods of improving a community's harvest and commerce by working directly with the citizens themselves.

In recent years, the Third World countries have put great demands upon their farm lands. Although food production rose for a short while, future harvests have been endangered due to over-cropping and over-grazing. Soil scientists, agricultural and environmental engineers are in great demand to advise farmers in high-crop-yield management. A volunteer's responsibilities might include soil-testing, fertilization counselling, or introducing modern farming equipment.

There are growing demands for water made by the peoples and farmlands of developing nations. But the combination of pollution and climatic changes has created a water shortage throughout the Third World. Water and sanitary engineers are needed to assist with new water management programs. The creation of sewage and treatment projects will replace traditional methods of waste removal that present health hazards to a rising population. Engineers are also needed to locate and utilize new sources of drinking water. An important function of the volunteer is water management education in the community. By learning the simple techniques of water and sewage treatment, the community is able to prevent disease and insure a clean water supply long after the PC volunteer has left.

The host country often invites the Peace Corps to assist in creating a network of structures and roadways. Known as the infrastructure, this network allows easier access by markets to and from remote agricultural areas. The PC engineer plays an important role in the development of this infrastructure.

Jim Sumwalt, a UW Civil Engineering graduate student, has recently completed a PC assignment developing

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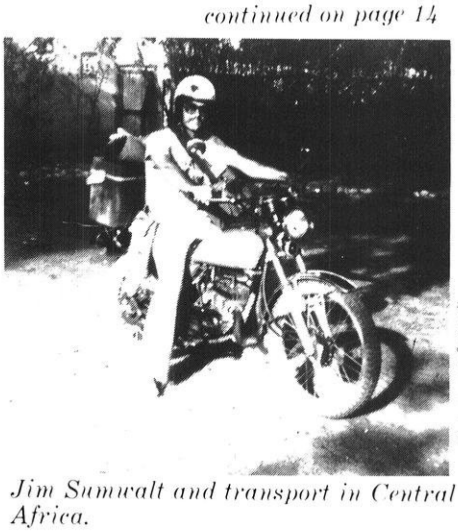


Photo by Jim Sumvalt

Jim Sumwalt and transport in Central Africa.

Peace Corps
(continued from page 10)

A community built storehouse.

this infrastructure. Jim's primary responsibility was the design and construction of a network of bridges in a developing river valley in the Central African Republic. The river valley is being prepared for agricultural development by the West German foreign aid agency. In order for the West German program to succeed, dependable bridges are needed to handle continuous use by heavy supply trucks and the strong water currents created during the rainy season.

Besides his bridge work, Jim Sumwalt designed and construccted buildings for commercial and domestic uses. A network of storehouses allows the community to store excess farm produce for the dry season, during which grain demand increases. The stored grain provides food for the community and sells for higher prices at the city marketplace. Jim and his village also set the foundations for a new school house.

Peace Corps engineers are also challenged by the developing area's energy needs. The volunteer is called upon to instruct villagers in the conservation of its traditional energy supplies (firewood and animal matter). New energy sources are also in great demand. Appropriate technology projects might include the following: the design of simple solar devices, particularly for grain drying and water heating; pedal-powered devices for grinding grain; and harnessing wind and running water, which produce energy for commercial and domestic use.

The construction of school buildings is only part of the volunteer's contribution to the community's educational base. By working on projects with the villagers, the volunteer is able to teach engineering and construction skills that prove valuable to the workers after the project is complete. The workers are able to find new jobs with the skills they learned during the project. An important function of the volunteer is the training of a villager as an assistant, who will be capable of replacing the volunteer if his service draws to a close before the project does.

Through his service, the Peace Corps engineer will discover that he has learned and received as much as he's taught and contributed to his community. Most returning volunteers consider their cultural experience the most valuable reward, as well as knowing they have bettered the lives of many people.

The Peace Corps proves to be one of the best things to happen to a graduate engineer before entering the professional world. The Peace Corps engineer has a freedom to use his imagination and has project responsibilities not enjoyed by many in industry. Finally, the international experience has proved invaluable to engineers interested in working for the United Nations, the U.S. Agency for International Development, or private industries contracting overseas.

The demand for engineers in industry is reflected by the starting salaries offered to graduating students. The Third World's demand for engineers is reflected by its desire to improve its economy and environment. As a technological ambassador, the Peace Corps engineer acts as both catalyst and buffer for his host country's commercial development. The volunteer improves the standard of living for his community, and enriches his attitude towards himself and his profession. □

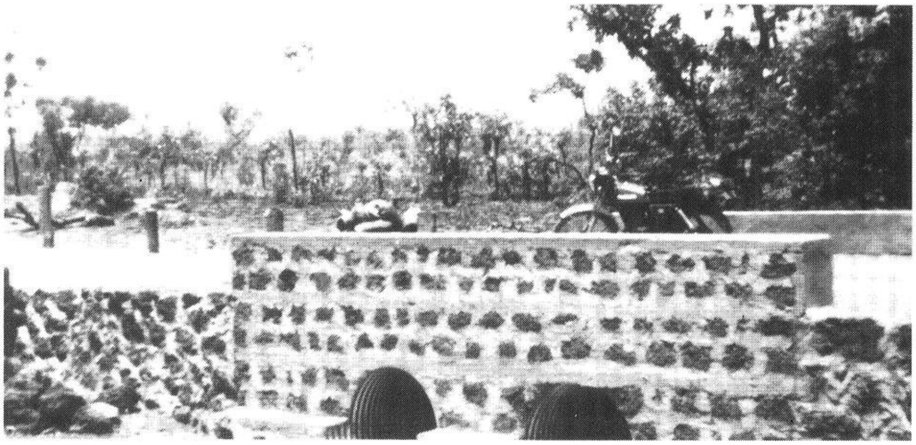
Graduate
(continued from page 11)

How do men view women engineers where she works? Susan replies, "Men are receptive to having women on the staff, and they are receptive to women engineers, but there's still an ingrained bias against women." She adds that this is particularly true of men aged 45 and over who were conditioned by their era's image of the male engineer. Susan claims that this bias manifests itself in grouping. "The male engineers get together and talk and the female engineers get together to talk." She feels that this bias does not hinder her work at all, but "you like to work with people you're very comfortable with, and if they have this ingrained biased attitude like, 'Oh, well, you're a woman. You're going to go off and have children and you won't be here very long,' it can be uncomfortable."

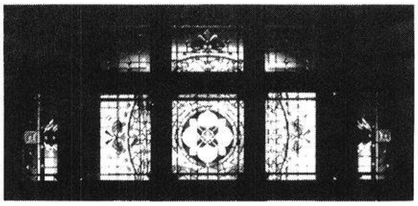
All in all, Susan LeVan is very satisfied with her job at Forest Products Laboratory. "The Lab is a good place to work, and I enjoy it. I feel like I have a lot of freedom for just being a B.S. chemical engineer."

"Just a B.S. chemical engineer" carries added strength though. Susan admits, when the phrase is coupled with "from the University of Wisconsin-Madison" Having also attended the Engineering College of the University of Virginia, she can compare the two schools' departments. "I rank Madison's Chemical Engineering Department very highly. They made me work, I had a lot of good teachers, and I really think I learned my stuff."

A highly trained engineer, to be sure. And if survival of the fittest is in fact a valid principle, life after graduation for Susan LeVan and other engineering alumni should be prosperous indeed. □



Dependable bridges are essential to connect remote districts with outside markets.



Engineer's Library

An Enemy of the People

by Henrik Ibsen

"An Enemy of the People," by Henrick Ibsen, dramatizes ethical problems created when engineering decisions are made for political reasons. The play's hero, Dr. Stockmann, must choose whether or not to expose an environmental crime. If he does so, he will risk the security of his family and career. Though the play was written in 1882, many parellels can still be drawn between this conflict and those which a future engineer may encounter.

The play is set in a Norwegian village expecting a commercial boom from its newly-built health resort. Dr. Stockmann, the main character, is a town hero since it was his idea to develop nearby mineral baths into the health spa. Stockmann's brother, Peter, the town's mayor, claimed equal credit for the project, having used his political power to see the undertaking through.

As member of the investor's board, Peter had more authority over the project than his brother, even though Dr. Stockmann was the best informed staff member. Dr. Stockmann proposed that the spa's needed waterworks be built upstream of local industry, but the mayor ordered construction of the water intake closer to the baths to save money.

The play begins years after the intake's placement, when Dr. Stockmann discovers that the water system of the health spa is being polluted by the tanneries upstream. The water, carrying toxins, is seeping into the mineral baths, causing a great health risk. Dr. Stockmann does not plan on saying "I told you so" to the mayor and rejects the possibility that people will consider his discovery a political victory. He believes the community will immediately take measures to solve the problem. Though the cost to relocate the waterworks and close the health spa for reconstruction will be enormous, Dr. Stockmann knows the village would pay more dearly for the inevitable outbreak of typhoid and gastral diseases.

The mayor, on the other hand, considers only the votes he will lose when it becomes publicly known that the improper intake placement was his fault. After an unsuccessful cover-up attempt, the mayor uses his political wiles to gather opposition to his brother. The villagers seem to forget their support for the doctor after the mayor announces that the necessary repairs would be financed by a tax-hike. The village merchants also withdraw their support after the mayor points out they will lost their tourist business if the baths are temporarily closed.

Realizing his brother is playing politics with the town's health, Dr. Stockmann makes an even more important discovery; the contamination of the water is analogous to the pollution of the mind. As the villagers cannot see the toxic bacteria in their water, they are equally blind to the corruption of their society. The announcement of this discovery only increases public embitterment towards Dr. Stockmann. At the play's end, Dr. Stockmann is cast an enemy of the people and left isolated by the villagers.

Professional engineers can also find themselves in Dr. Stockmann's position. The engineering community has the responsibility to share Dr. Stockmann's personal and scientific ethics. An engineer often must carefully balance the importance of following his training with the need to satisfy society's demands.

"An Enemy of the People," which can be read in one night's sitting, illustrates situations that could confront the engineer during his professional career. - *Reviewed by John Wengler* □

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instance, Dave worked in the purchasing department at Danley and saw what raw materials were needed by the plant. He also worked on the drawing board for a while. He commented, "The drawing wasn't very difficult. It didn't take a whole lot of creativity, but just reinforced the basic skills. A lot of engineers get a drawing job first, then go into design later on."

Unlike most engineers, Dave is pretty sure of what the future holds for him. "My plans are to interview with as many companies as I can, including Danley, and take the offer that suits me the best. I plan to go into sales, and I feel I have a little bit of an advantage. No matter what company or industry I go into, the skills and the knowledge I've gained in the co-op program will give me an advantage over someone who has just stepped out of college and has no work experience."

If you're an ambitious engineering student looking for a job that not only pays well but also gives you a look at the world of engineering, maybe the Cooperative Education Program is for you. □

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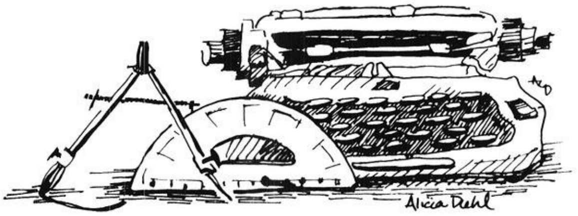
exam tests the applicant's knowledge of biology, chemistry, and physics, as well as assessing general reading and quantitative skills. MCAT scores, grade points, and letters of recommendation are three of the most important criteria by which students are judged to be or not to be physician material.

Although Kevin didn't find his special background to be especially helpful, engineering schools must be doing something right in preparing potential doctors. A very high percentage of applicants with biomedical engineering degrees are eventually admitted to medical school.

Did majoring in engineering, rather than in the more traditional disciplines of biology or zoology, at all hamper Kevin's first year performance? He doesn't think so. "You really only need to know enough biology to pass the admissions test. Everything else you need to know is covered in your medical school courses."

All in all, Kevin's experience seems to show that while studying engineering doesn't necessary help further the career of a person interested in medicine, it sure couldn't hurt - especially if that pre-med applicant *doesn't* metamorphasize into a medical student. □

Bits & Threads



Did you ever think that an empty beer keg would be an important piece of apparatus for scientific research? Rick Rohrer, graduate student in Nuclear Engineering at UW-Madison believes so. He's using an empty half-barrel as a pressurized reservoir for liquid Freon-11 in an experiment that will help explain the physical processes in the early stages of a nuclear meltdown. "Not only is the beer keg the most effective reservoir," says Rohrer, "but it's also by far the cheapest of the alternatives I considered. Since this project is federally funded, that helps save the taxpayers some money."

The Defense Department is encouraging industry to support more research at universities to "speed the transfer of technology from basic research into production of weapons systems," a top Pentagon official told Congress recently.

Richard D. DeLauer, Under Secretary of Defense for research and engineering, said he was recommending that companies receiving defense contracts provide greater financial support to university research. He told the Senate Defense Appropriations Subcommittee that this would "foster closer cooperation between academia and industry" and reduce the time before the results of basic research supported by the agency can be applied.

--The Chronicle of Higher Education

The search continues to determine whether or not boys are inately better at math than girls. At Johns Hopkins University a study of 10,000 seventh and eighth graders found that twice as many boys as girls scored over 500 on the mathematical portion of the SAT's; at the 700 level, the ratio was 14 to 1.

A study at the University of Chicago, however, suggests that math is not, after all, a natural male domain. A specialist in high school math curriculums studied the ability of 1,366 tenth-graders to solve geometry proofs. Because this subject requires both abstract reasoning and spatial ability and is never learned outside of school, environmental factors are screened out. The researchers found no sex differences in ability.

University of Wisconsin Professor Elizebeth Fennema believes both sides are missing the real target. She has been studying sex-related differences in math ability for twelve years and maintains that most female math disabilities result from environment. Indeed, the researchers all agree on one important point: if boys and girls are given capable teaching and comparable attention, both will achieve.

--Time Magazine

Following a nuclear attack on the United States, the U.S. Postal Service plans to distribute Emergency Change of Address Cards. "This postage-free card," the Postal Service's emergency-planning manual explains, "would be used by displaced survivors of an attack to notify the Postal Service of their emergency mailing addresses." The manual gives several examples of completed cards. One sample, for a (Mr.) William Thomas Butler, gives a "pre-emergency" address of Upton Street in Washington, D.C., and says that he can now be reached at Box 21, Leesburg, Virginia. But the sample card filled out for (Miss) Mabel Jane Butler tells a sadder story. Her preemergency address, like Butler's, was on Upton Street in Washington; her present address, however, reads: "Deceased, Mortuary #10, Falls Church, Virginia 22040."

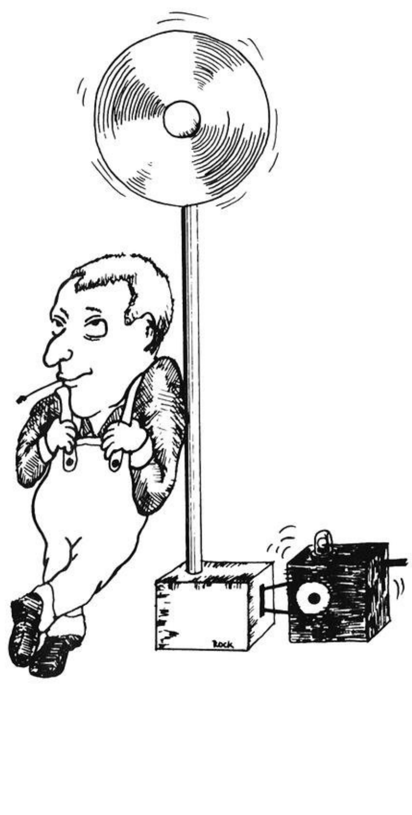
--Esquire

Small power producers won a victory in January when the Public Service Commission ordered net energy billing for generators under 20 kw. The ruling means that owners of small wind generators can sell the power they produce back to the utility at the same rate the utility sells to them.

Net energy billing had strong support from the Citizen's Utility Board (CUB), a non-partisan group keeping check on all public utilities. According to CUB staff attorney George Edgar, both the utility and consumer gain from this decision. The producer makes more money because he is guaranteed that he can sell any excess power at retail rates. The utility profits because the current meter simply runs backwards and eliminates the need for an expensive new meter.

Other consumers save because as more people see the profit in becoming a small power producer, there will be less need for new power plants and the higher electric rates that go with them.

--CUB Prints



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