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Volume 82, No. 4 Spring 1978

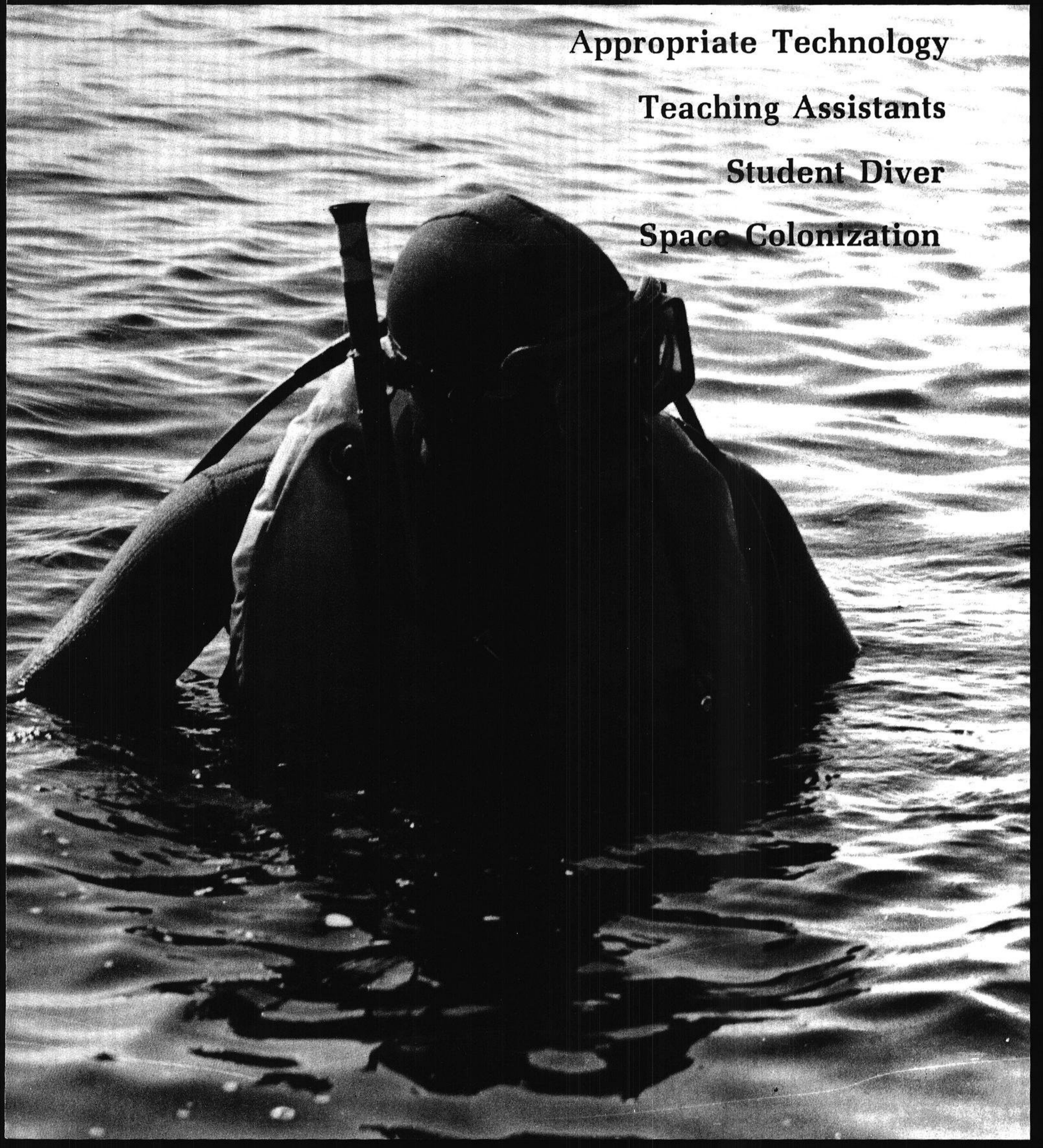
wisconsin engineer

Appropriate Technology

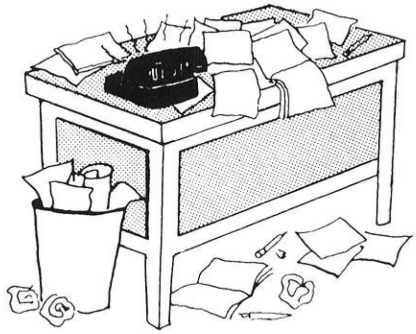
Teaching Assistants

Student Diver

Space Colonization



FROM THE DESK OF THE EDITOR



The Faculty Senate recently adopted a new regulation referring to the familiar grade point average. It doesn't "change" anything. It merely "adds."

Issues brought to the floor that evening included:

- The overabundance of "honors" students. Approximately 60 per cent of those graduating from the School of Education are honors graduates, as reported by the *Daily Cardinal.*
- The meaning of honors.
- The Honors Convocation.
- Honors in the College of Engineering.

The regulation that passed that evening established a new title, "graduate with distinction," granted to those graduates in the upper 20 per cent of their class. These graduates will be the only ones to attend the honors convocation.

Currently, an engineering student graduates with honors if his grade point average (G.P.A.) is 3.25 or better. He graduates with high honors if his G.P.A. is 3.75 or better. He will now graduate with distinction if he is in the upper 20 per cent of his class in the College of Engineering.

Therefore, there are honors students who will graduate with distinction and honors students who will graduate without distinction.

Confusing? Not as much as some of the policies in the College of Engineering. But that will change, too.

The confusion results from policy differences between the College of Letters and Science and the College of Engineering.

If an L and S student is to graduate with honors, he must be a part of the Honors Program and he must take specific classes designated as Honors Courses.

On the other hand, an engineering student does not have to belong to a specific program to receive honors at graduation. However, his diploma does not designate him as an Honors Student. The L and S honors student has "Honors" printed on his diploma.

Drop dates and part-time classification also differ in the two schools.

Much has been said about these differences. Questions of fairness and consistency arise.

As a result, the Faculty Senate included a statement in the recent regulation stating that "the College of Engineering can do as it sees appropriate," according to Dean Fredrick Leidel.

Will anything change as a result of this? Or will it become more confusing?

BE IT RESOLVED

Abortion, nuclear power and the coal strike.

Engineers should be aware of national issues such as these. More important, we should be aware of government a little closer to home—the Wisconsin Student Association (W.S.A.)

As I sat in the Senate one past evening during a particularly dry piece of parliamentary preposterousness, I started wondering if real government is as embattled as WSA seems. Full Senate consideration is granted to few motions or topics debated.

Yet it seems this could be resolved if we, as engineering students, became involved.

When American society becomes concerned about a particular issue, some body will commission a committee, task force or "expert" to investigate and report back. The body is invariably associated with some branch of government. Usually the more people concerned, the higher the level of governmental response.

We are the future "experts."

When engineering students graduate, accepting jobs in industry, most seem to disappear and settle in comfortably somewhere. I would hope that in some capacity we also become involved in the politics existing in our locale.

Gaining experience and insight in our areas of competence, we, as engineers, should make an effort to become involved in the issues, procedures and questions of today. In addition, we should be available to share our knowledge when a "body" requests.

Any decision with technological content, effect or affect, must be made with a corresponding understanding of those concepts. Engineers have a responsibility to ensure that public and governmental understanding of technology is adequate and accurate.

We have to involve ourselves in the decision-making process and become a force in political affairs. We must be aware of and competent in the procedures and active participants in the meetings.

As engineering students, it is obvious that we do not know everything. We do leave with a hefty bag of tricks, though, and society benefits from our attention. Individually, we must each do our share.

Where to begin? Try the WSA polls in April.

wisconsin engineer

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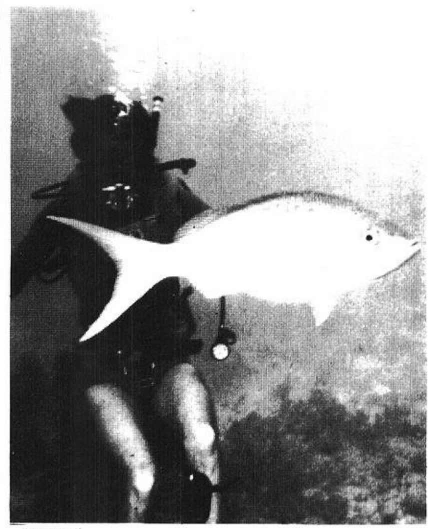
FEATURES

COLUMNS

Cover photo by Ron Kading



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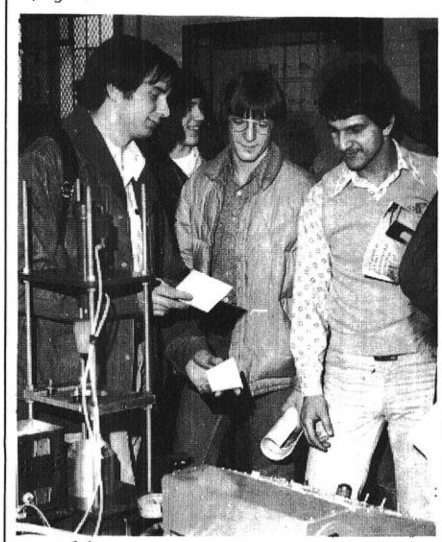

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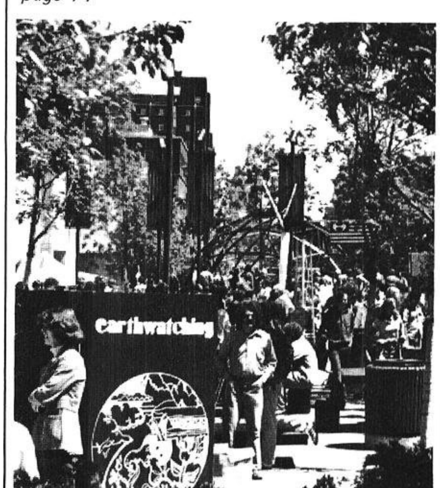

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ENGINEER POSES AS FISH BAIT

Dennis is set to venture into the depths, fully equipped with air tanks, lead, buoyancy compensator, fins, snorkel and mask.

by Sue Tyunaitis

Darkness everywhere. A black, warm chill envelops him in an aquatic serenity. Occasionally, a few friends nudge him softly from behind. Friends, yes. He is an intruder, yet is accepted as one of them.

He is different from them, with his blue wet suit and air tanks designed so he, too, can breathe underwater. Yet he does not pose a threat to them. He is there merely to observe, to learn, to escape.

The underwater world is peaceful and serene, with its own phase of danger and excitement–and it is far away.

Away from the books, the pressures and the exams encountered in his day-to-day life as a student, Dennis Hilgendorf becomes one with the underwater environment.

A junior in Mechanical Engineering, Dennis admits that he seldom has time during the semester to avidly pursue his diving interests.

"I go out diving about twice a week during the spring and summer. And I'm lucky if I get out once a week during the fall and winter," he says. "Whenever I get the chance, I go to explore."

His explorations have taken him to Florida and South Carolina oceans and gulfs, as well as to Wisconsin lakes and quarries during the past year and a half.

Both a hobby and a sport, Dennis' diving began out of curiosity and interest.

"After looking at the ocean from above through a glass-bottom boat while in Florida, I wanted to see everything from below," Dennis said. "And I knew I would like it before I ever started."

While "under," Dennis photographs what he sees, collects anchors and bottles, and occasionally explores submerged ships and cars.

"Each time I go diving it's different," he says. "There is always something new to see and to experience. It's totally different from other sports."

And the difference is not seasonal for Dennis. He dives in all seasons.

On a cold, icy day in February, ideal for sitting in front of a warm fire studying Thermodynamics, Dennis may be found crawling out on the ice of Lake Mendota, garbed in his wet suit and air tanks, carrying a chainsaw and shovel. He is ready to clear the ice, saw through, dive in and explore the depths.

Crazy, when facing a windchill of forty below? Not so, according to Dennis.

"It's warm beneath the surface," he claims. "The temperature underwater is about 38 degrees during a Wisconsin winter. The only time you get cold is when you emerge."

While emerging from a "cold weather dive," Dennis often turns into a human icicle.

"In that case, you just jump in again to thaw out. Then, you run to the heated tent nearby."

What would possess him to dive in below zero weather?

"When I heard that the visibility in Lake Mendota was between 50 and 100 feet during the winter, I couldn't resist," he said.

Compared to visibility of 15 to 20 feet in early spring and a murky 5 feet in the midst of summer, Lake Mendota in the winter is "a diver's wonderland."

Other local areas Dennis finds intriguing include: Governor's Island for its perch and anchor abundance; Door County for its sunken ships and cars; and James Madison Park for its Civil War relics.

Wherever he is diving, Dennis finds that the underwater darkness of winter adds danger to the sport.

"While under, the lifeline attached to you and the other diver may break. In that instance, it is virtually impossible to see the triangular hole made in the surface of the ice."

For that reason, winter divers generally go in groups of five: two below, two above, and one emergency diver.

When the lifeline goes slack at the surface, the emergency diver submerges. He circles the area beneath the surface with a 450-foot line. The "lost" divers come to the surface and feel the line as it passes them. They then latch on to it, and follow it to the hole.

Dennis has not yet broke a lifeline nor encountered a shark while diving. He has had a wealth of memorable experiences, though, ranging from being nudged from behind by an "unknown" to soaking his camera and losing his knife on the same day.

But underwater life does not pose a danger, says Dennis.

The sharks, moray eels, barracuda and jellyfish have accepted "The Blue Frog" as one of them. (Dennis was given the nickname by a high school friend.)

"They are there, and you are there. You can't avoid them, while they can't avoid you. In the end, everyone just minds his own business—most of the time."

The first time Dennis dove, he was amazed that fish would come up to him and eat out of his hands.

"And when you are swimming through a school of fish, they just part to let you by," he said. "It must be some sort of instinct."

This peaceful environment can turn into one of turmoil while in an ocean.

"When you're about 65 feet under, you don't realize that the seven foot waves can reach you while you are surfacing," said Dennis. "You could be swimming along and be thrown about five feet by the currents in an instant.

"Most people don't realize that you can only surface at 60 feet per minute. Otherwise, air bubbles form in your lungs."

Although he pursues the sport avidly, Dennis does not think it will become a career-related hobby.

"I don't see any reason to go into it in any more depth. It's just a great get-away for me."

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Dennis and friend in a wetsuit and gear on a below zero day in February. *Photo by Ron Kading*

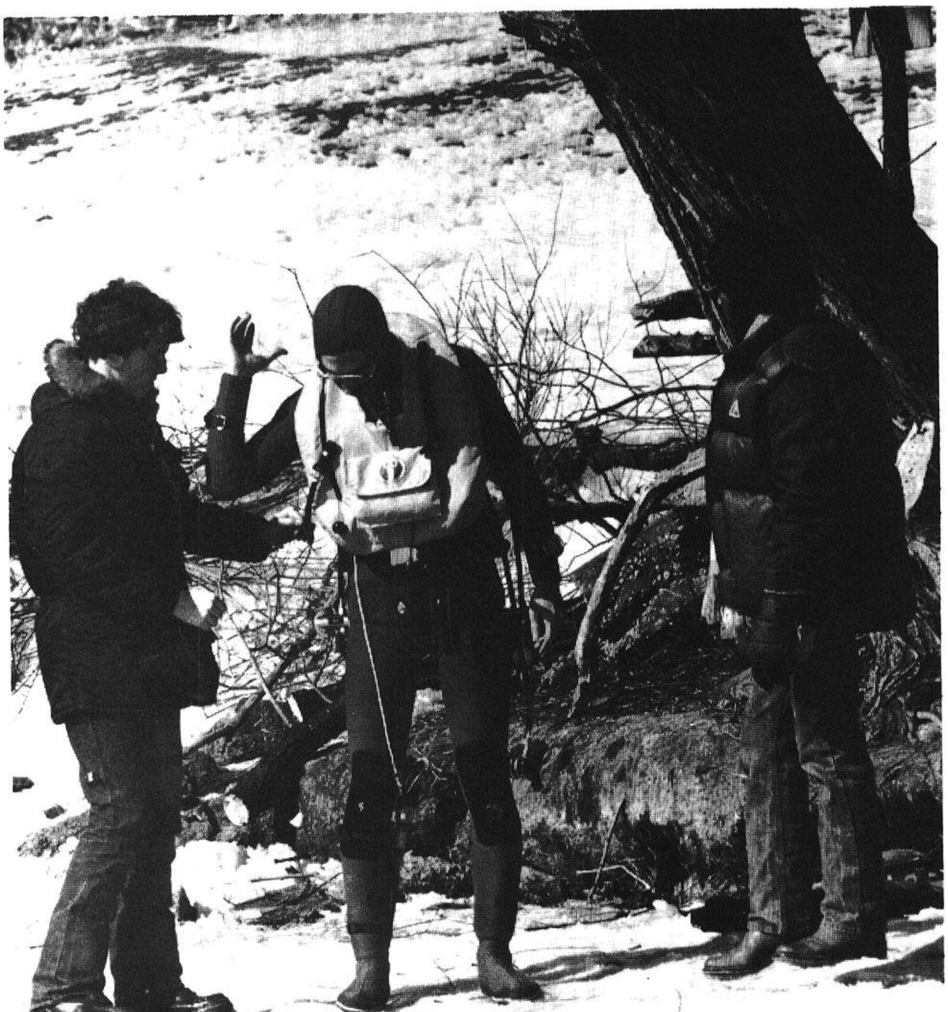

Photo by Ron Kading

Members of the Capitol City Diving Club assist Dennis in preparing for an icy dive.

The get-away is not something he can do on impulse. While diving, Dennis is equipped with a 40-pound air tank and 24 pounds of lead—this is in addition to his wetsuit, regulator, buoyancy compensator, fins, snorkel and mask.

The equipment is the major investment for the sport. Dennis has spent over $1000 on underwater diving gear, including his photography equipment.

Yes, Dennis also manages to combine another hobby with diving—photography.

He notes an interesting phenomenon: "The non-diver, who experiences the underwater world through my photographs, sees a fantastically colorful environment, thanks to the camera's flash."

But to the diver beneath the surface, reds disappear at eight feet; oranges go at 12 feet, and below 40 feet, there's nothing but green and blue.

As Dennis sinks within the depths, the water absorbs all ultraviolet rays. Light fades.

Darkness is everywhere.

—Sue Tyunaitis is a junior Engineering Mechanics student. She is editor of the Wisconsin Engineer.

Plant & Maintenance

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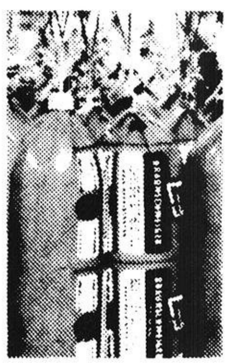
at Oscar Mayer



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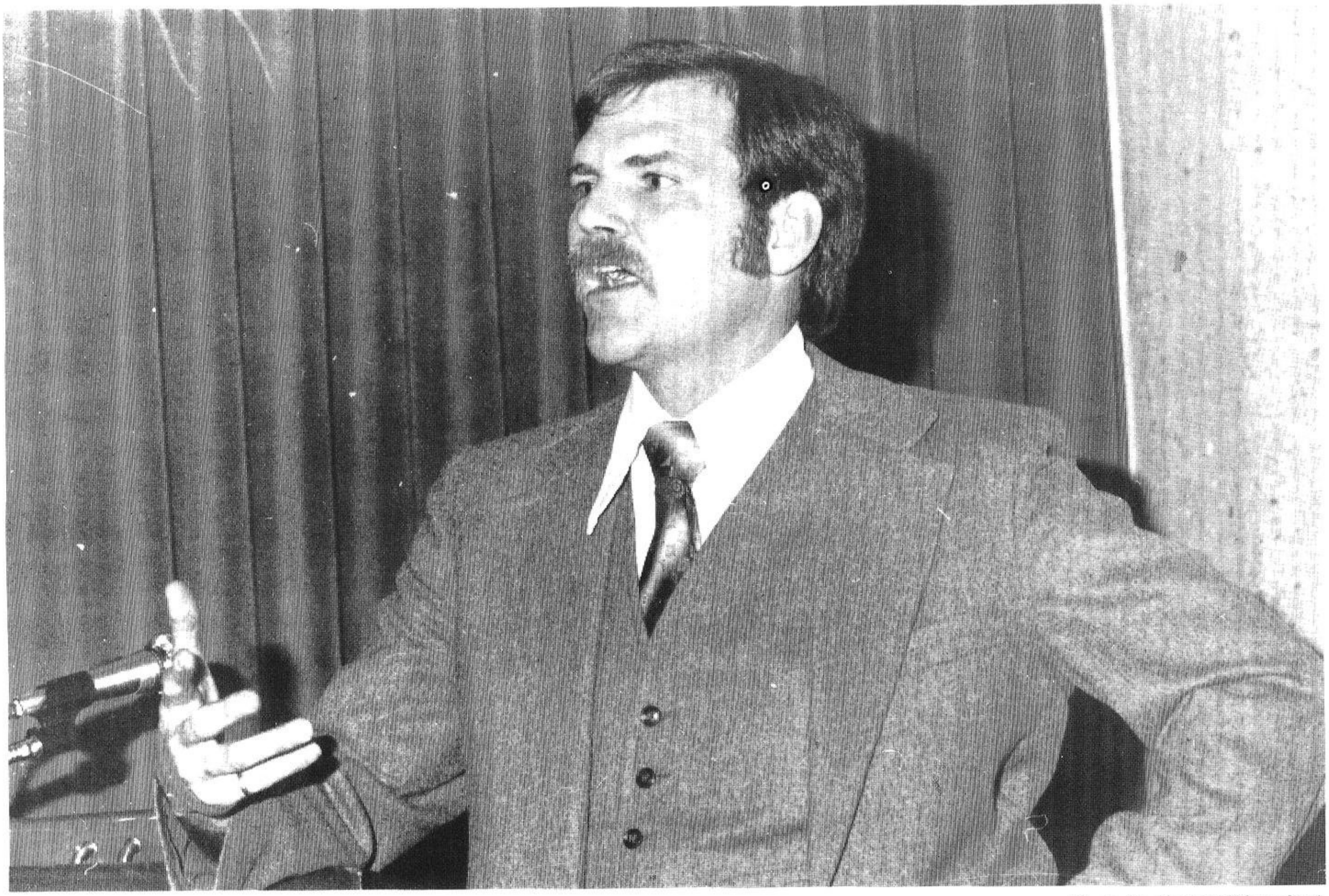


Photo by Dennis Hilgendorf

Professor Harold Jebens presents his ideas on space colonization as part of Engineering Week activities.

ONE MAN'S DREAM

by Tom Locante

Dr. Harold Jebens is a man who wants to go to space. He also wants to take 10,000 fellow humans with him. And he wants to do it now.

Dr. Jebens, professor of Civil Engineering at UW–Platteville, and a UW–Madison alumnus, wants the U.S. to spend $200 million–$10 billion a year–to build the first space colony.

Jebens gave a slide presentation and talk on Tuesday, February 21 at Union South as part of the National Engineering Week events. As a result of his participation in an eight-week NASA design program at Ames Research Center in Iowa during the summer of 1975, he is now pushing hard for the creation of a space colony.

The goals of the summer study were to come up with a permanent space community of 10,000 people in space. The community was to be psychologically safe, socially viable and economically feasible.

What evolved from the study is an "inner tube in space"–an inner tube which has living quarters for 10,000 people, farms and domestic animals to feed the people, and earth landscapes and features, all in a closed system.

The inner tube rotates fast enough to simulate earth gravity, and is protected from solar radiation by a radiation shield.

"Imagine the space station as an inner tube and the shield as a tire, with the inner tube rotating inside the tire," says Jebens.

How do we get the space colony up there? Jebens says, "When you want something this large in space, you must actually *build it* in space." The first step, he says, is to build a mining facility which would tap the moon's resources–the moon has all the necessary minerals–and send them out to where you are going to build your space colony.

Once the space station is built, it would serve as a place to manufacture a factory, which would in turn be used to fabricate the necessary parts for the colony.

Compared to getting resources into space from earth, getting them into space from the moon is very inexpensive and relatively easy. The raw materials would be shot into space by what Jebens calls an "electric slingshot."

What the slingshot does is throw huge payloads of raw materials in buckets out to the space station factory at a rate of one per second. Here they are caught by a mass catcher, which Jebens says looks like a "giant butterfly net."

The raw materials are then used to build a factory to manufacture sheet aluminum and glass for the space colony's radiation shield.

Jebens himself is interested in designing the life support system for the colony. On the Jebens "space diet," colonists would receive 25 grams of four different protein sources—fish, chicken, rabbit, and beef—plus some vegetables every day. Their daily supply of 250 kg of water would be the same water which watered the animals and plants, and was purified by the plants.

Jebens, who desperately wants the chance to get into space, says, "I want to design a life support system so complex only I know how to run it. That way they have to let me go to space!"

Jebens asserts that one of the most important reasons for a space colony is the need to solve the population problem on earth: "The earth's population is growing at a truly explosive rate; a space colony—or perhaps several of them—may be part of the solution."

Jebens says that space colonies are good places from which to start further exploration of space. He also wryly notes that in case something goes wrong on earth, like a nuclear war, it would be nice to have a few humans up in space to carry on the human race.

—Tom Locante is a sophomore Journalism student who plans to pursue a career in newspaper or magazine writing.

POLYGON: Your Student Engineering Council

by Nikki Abramoff

Define "polygon."

If you said it's a many-sided figure, you're close.

Polygon was established in the 1920s by the engineering college faculty to be a representative student council. Its purpose was to organize the engineering students in a professional fashion. Polygon has gone through many changes since then, but its composition remains the same.

The Polygon Council is comprised of 25 voting members—two delegates from each of the 12 student professional societies in engineering, and a chairman to preside over the meetings. The faculty advisor is Professor Jim Marks, head of Engineering Placement.

How much do you know about Polygon's activities? The few of you who are even aware of its existence seem to think of Polygon as a "do-nothing" organization that students only join so that they can have something fancy to put on their resumes.

Look again. Polygon is alive and well. We work behind the scenes to bring engineering students a wide variety of services and activities.

Few engineering students could have escaped hearing the phrase "St. Pat was an engineer" by March 17. That's because Polygon saw to it that the old rivalry between lawyers and engineers was once again revived in the St. Pat's Day engineers vs. lawyers basketball tournament. And many engineers partook of their share of green beer at the Engineers' St. Pat's Day party held to celebrate the annual engineer-lawyer clash.

And Polygon does a lot more than serve green beer.

For the past few semesters, Polygon has run a book co-op to aid students in buying and selling their books apart from the expensive University Bookstore.

Polygon also plans and sponsors the fall and spring engineers' picnics, and the senior awards banquets.

Polygon plans and runs the activities for National Engineers Week.

Polygon sells UW College of Engineering jackets (for the reasonable price of $13!)

A Polygon committee is researching and evaluating the senior-credits system, the possibility of changing the college of engineering drop date, and the judging system for the senior service awards.

Polygon works closely with the Deans and faculty of the College in many of these areas. It would help greatly if we knew we had the interest and support of engineering students.

Within the past few months, Polygon has undergone a major internal reorganization in the hopes of creating an even more effective student council. The Council is now divided into five committees—the Services Committee, the Social Committee, the Public Relations Committee, the Internal Administration and Funding Committee, and the External Administration and Awards Committee.

Polygon exists to serve engineering students. Our office is located in room 23, T-24 in the Freshman Engineering Building. If there's a job that needs to be done, or a service that needs to be performed, let us know.

There are over 3,000 students enrolled in the College of Engineering. Twenty-five of them are members of Polygon. We'd like to see more of you involved in planning and organizing our activities. If you are interested in learning more about our activities, call our President, Joan Nielsen (255-6594), drop us a note in the Polygon mailbox in the Mechanical Engineering lobby, or drop in and visit the Polygon office in 23, T-24.

Well, if you said Polygon is a many-sided figure, maybe you were right after all.

—Nikki Abramoff is a junior Metallurgical and Mineral Engineering student. She is a member of Polygon's Public Relations Committee.

Photo by Dennis Hilgendorf

by Ken Kusel

The College of Engineering has been convinced since early in the 1960s that it is an illiterate engineer today who graduates without knowing how or when to use a computer.

In light of this attitude, the College maintains the Engineering Computing Laboratory (ECL) to provide free access to a computer for all UW engineers–undergraduates, graduate students, faculty and staff.

Established in 1961, ECL provides instructional support to engineering students.

According to Professor Charles Davidson, ECL Director, two-thirds to three-quarters of ECL's facilities are currently geared toward instructional purposes. Students are encouraged to use the computer freely for short jobs, including assigned homework, laboratory data, work for other courses, or just plain experimentation. The concept of open access, the ease with which ECL's system operates, and the quality and quantity of services provided to the students have attracted national attention among both engineering and computer educators.

Bill Lageroos, Assistant Director of ECL, notes that the computer facility has experienced growing pains over the past several years. Even with additional equipment in 1971 which improved computational capacity by forty-to-one, ECL experienced a rapid increase in usage during the years of 1971 to 1974. This increase finally began leveling off in 1974 to a capacity of 200,000 jobs

ECL is currently undergoing a $60,000 expansion. Physical expansion of the facilities began last December, and until completion sometime in early spring, should provide no foreseeable inconvenience to users.

per year with an average turnaround time of two minutes per job. But, due to increased enrollment and courses requiring computer time, ECL is once again experiencing an increase in usage and a desperate need for additional space.

To alleviate the additional burdens of increased usage, ECL is currently undergoing a $60,000 expansion. Physical expansion of the facilities began last December, and until completion sometime in early March, should provide no foreseeable inconvenience to users. An additional 1600 square feet of floor space will be a welcome sight to users now familiar with over-crowding.

In addition to physical expansion, there will also be increased computational expansion with the installation of a new Harris 6024/6 computer and memory unit. The Harris/6 will be connected to the current Harris/3 with an interface designed, built and tested by the staff of ECL.

Initially, users will see no change in the way these jobs are executed, for the plan is to use the /3 computer as a "front end" to the /6 computer, letting the old computer handle all input and output operations and sending the jobs to the /6 for processing.

Job processing is expected to be fifty per cent faster, however. And since the /6 has considerably more memory, there will be fewer overlays.

During the winter, the staff will be working on adapting Harris' operating system to the needs of ECL. Conversion to the new system should occur sometime this spring, at which time users will be required to learn new control card commands and new deck structures.

There are three distinct advantages to this system: 1) ECL will be able to run in a true "multiprogramming" environment, so that several jobs can be active in the machine at once. This in turn means that long jobs can be started during the day without having them hold up later short jobs; 2) With the new system, the user can exploit the "Virtual Memory" feature of the new computer, which will permit users to write programs as though a very large memory were available; and 3) more terminal activities can be carried on concurrently with batch operations without seriously impacting throughput.

In addition to these features, there will be terminals linked to the existing Harris /3 computer where a user can de-bug a program on line with the computer. This should greatly reduce the overload in the keypunch room. A new line printer will incorporate the use of upper and lower case letters for documentation. And finally, preliminary work this summer will be done to expand time-sharing capabilities over the next two to three years.

Expansion of the Engineering Computing Lab should further the goals of the College of Engineering by providing updated instructional support. Engineering students will have continued assurance of access to ECL, and fast turnaround time for short jobs. Already with an eye to the future, ECL heads the priority list to occupy the State Highway Lab across from the Engineering Building when that site becomes available.

Photo by Dennis Hilgendorf

Expanded facilities at the Engineering Computing Lab (ECL) will soon allow these students easier access to terminals.

—A senior Mechanical Engineering student, Ken Kusel plans to attend graduate school in either law or engineering.

TA ADEQUA

– Does Your

by Tom Locante

There are 205 professors in the College of Engineering. Some of the teaching duties of these professors fall on the shoulders of 136 teaching assistants.

A recent informal poll shows that most engineering students feel that their teaching assistants are quite knowledgeable in their respective subjects.

But the students are not always as certain about the TA's teaching abilities. One junior chemical engineering student summed up the attitude of many students: "For the most part they know their engineering. It depends on the TA. Some express themselves well. Some just don't know how to teach the material."

Other common complaints are that some TA's do not use class time correctly, or that a foreign student's accent makes it difficult to understand his lectures.

And despite the fact that TA's are hired to *teach,* there is no past teaching performance on which the selection of new TA's can be based. Nor is there any formal program established at the University to acquaint them with teaching practices once they are hired.

Professor Donald Novotny is Chairman of the Department of Electrical and Computer engineering. As head of the largest department in the College, he oversees the hiring of forty teaching assistants.

Novotny sheds some light on their hiring: "We are very concerned with teaching skills. Obviously, while all the applicants are very knowledgeable in engineering, not all of them are suited to teaching. We try very carefully to screen applicants in our interviews. We also rule out as TA's those who don't score well on the verbal part of the Graduate Record Exam (GRE)."

Administrators and faculty in the College believe that teaching skills are picked up only over time.

Associate Dean Robert Ratner says, "The best way to acquire skills in teaching is through experience."

Novotny echoes this idea: "Indeed, we have no formal program in teaching skills, but the only way to learn to teach is to teach."

In the Department of Electrical and Computer Engineering, several methods are used to provide TA's with the necessary training to do a good job:

A first-year TA is never put in a course above the first level. Novotny says that this lets a TA gain experience in teaching in a situation "where there is no question as to the TA's solid knowledge of the material."

As a TA gains more experience, s/he is placed in a position of greater responsibility.

TA's may also gain experience through activities which are called "supportive"—not in a direct teaching situation with a student. These activities include grading papers, operating proctor labs, and setting up special projects for a professor.

"There is a learning time, but it's learning by doing," says Novotny.

At the beginning of each semester, Professor Stremler (Assistant Chairman in ECE) holds a meeting for all new TA's. In addition to giving an informal talk on teaching, he hands out a booklet outlining some of the basic principles of teaching.

For many courses, the professor will meet with his TA's to discuss how the course material should be organized.

EXAMINED

a stinkk?

Ratner says that "if a TA organizes his material, knows his subject, and has an interest in his students and in teaching, in my opinion s/he will be a good teacher."

Foreign TA's, however, pose a particular problem. One engineering student complains that "One of my biggest problems is with foreign TA's. They are harder to understand."

Novotny agrees that "foreign TA's are a special problem." One-fifth of the 40 TA's in Novotny's department are not American. Although foreign students do not have to pass any special English proficiency test to be hired as TA's, Novotny says that in his interview he tries to be sure that there "isn't going to be any language problem."

Another problem with foreign TA's is a cultural one. Novotny explains: "In some countries teachers are revered almost as gods—some foreign TA's still have that attitude."

No foreign graduate student is given a TA position—or any financial support—in his or her first year as an engineering student at Wisconsin.

Each chairman handles complaints about TA's in their respective departments. Novotny says that direct complaints by students to the chairman are few and far between. This may be because it is frightening for a student to go directly to a department chairman. "Students are not quick to complain," says Novotny.

But he says there are other ways in which he can hear about problems with teaching assistants. One is a meeting he has with student representatives from various engineering organizations and professional societies.

This may not be enough to get all the required feedback. "We have 900 undergraduates in our department," says Novotny. "When you have five or six students functioning as a formal communication channel, the system may be inadequate."

Novotny feels that students should confront TA's more often and try to work problems out. Ratner also believes that "it is up to the student to go to the department with complaints."

According to Novotny, "We need a channel that involves less trauma than going directly to the department—perhaps the individual should be able to remain anonymous."

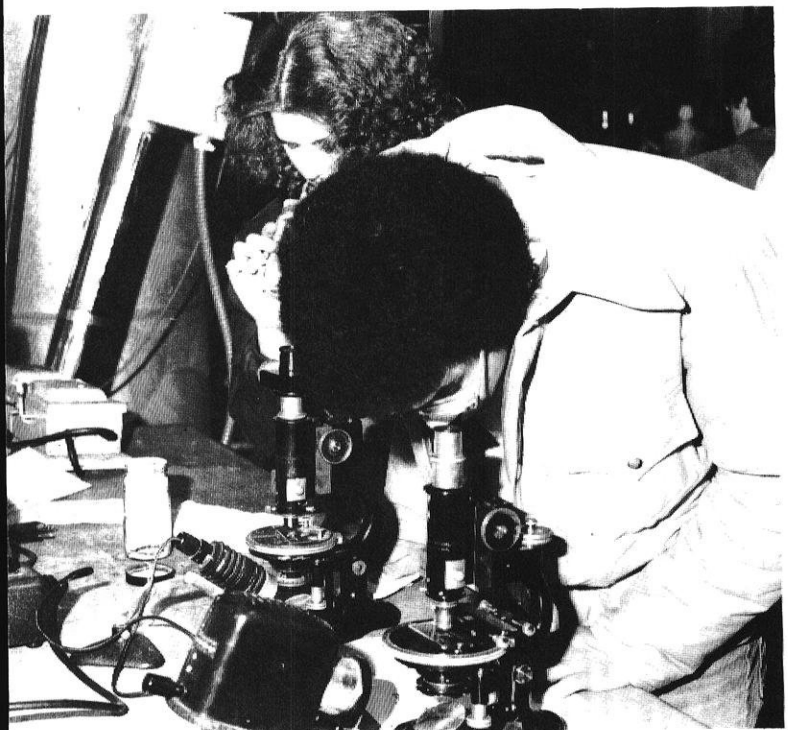
Another way to get information about the teaching skills of TA's is through course evaluations which students fill out at the end of each semester.

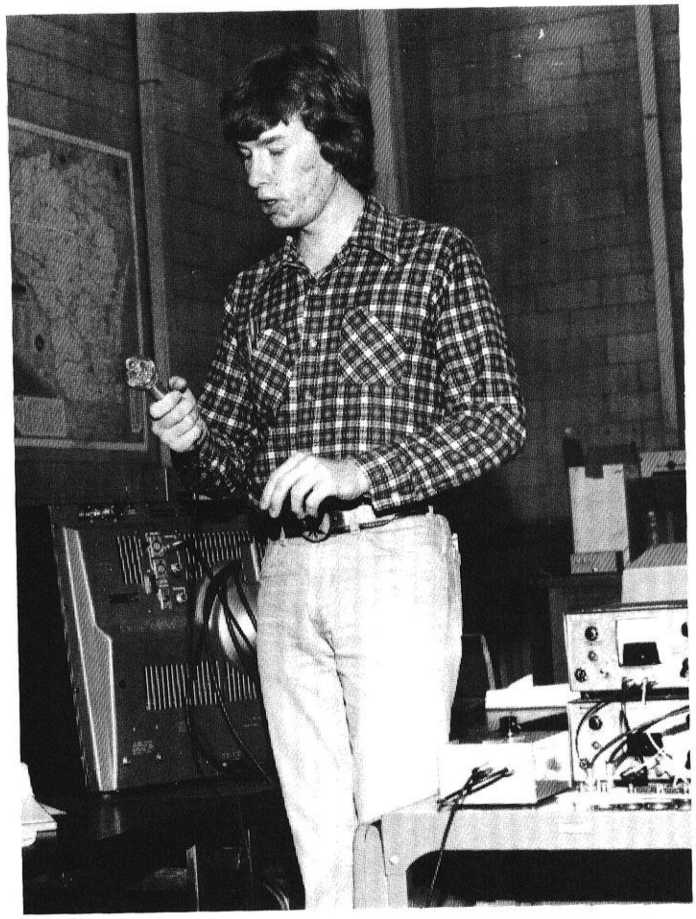
These evaluations are reviewed by a committee of two faculty, two TA's and two undergraduates. Novotny says that in his department there are usually only one or two TA's who are singled out as below average teachers.

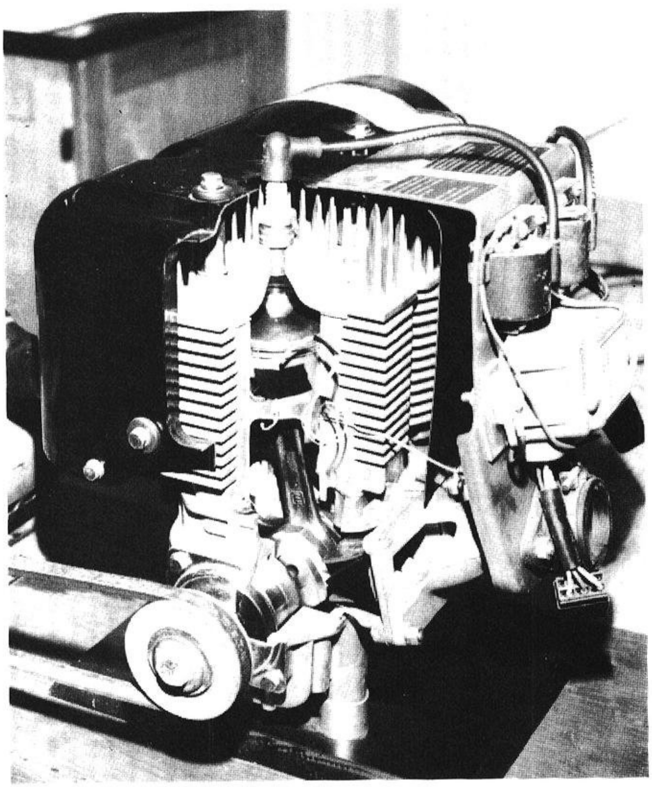
Few students seem to question a TA's knowledge of his subject, and administrators believe that TA's are doing an outstanding job. But TA's are often unprepared for the demands of classroom teaching, and some complaints that students occasionally may have don't always reach a level where something can be done about them.

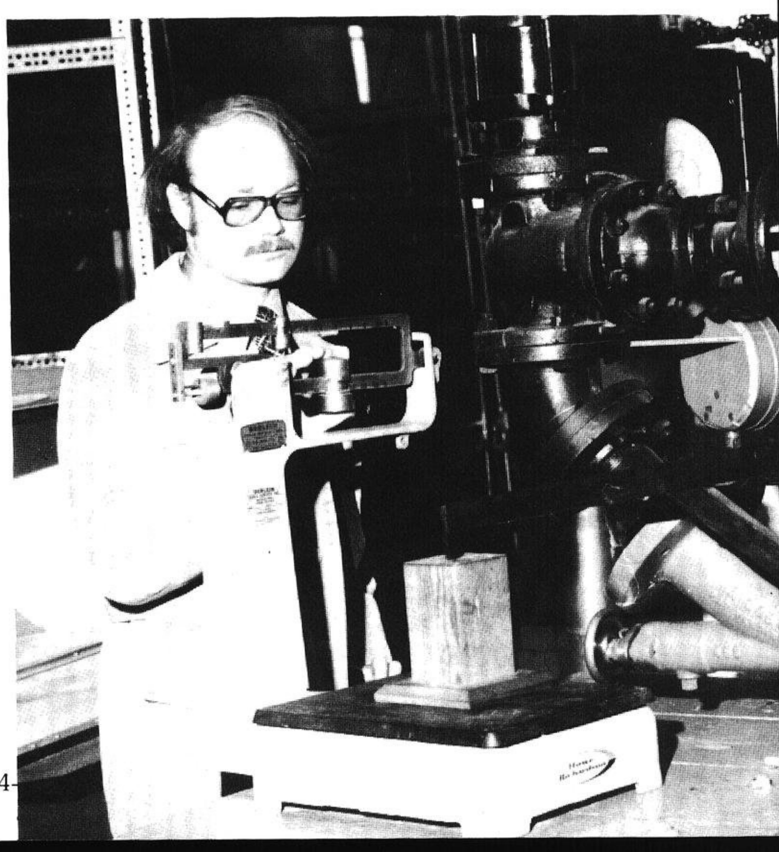
—Tom Locante is a sophomore Journalism student who plans to pursue a career in newspaper or magazine writing.

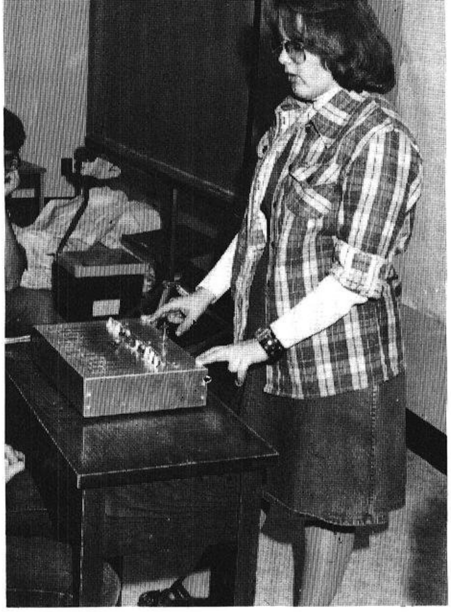
NATIONAL ENGINEERS WEEK

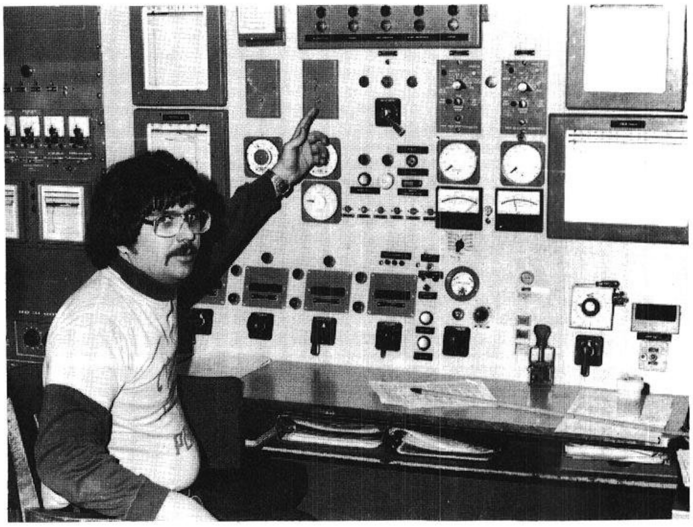


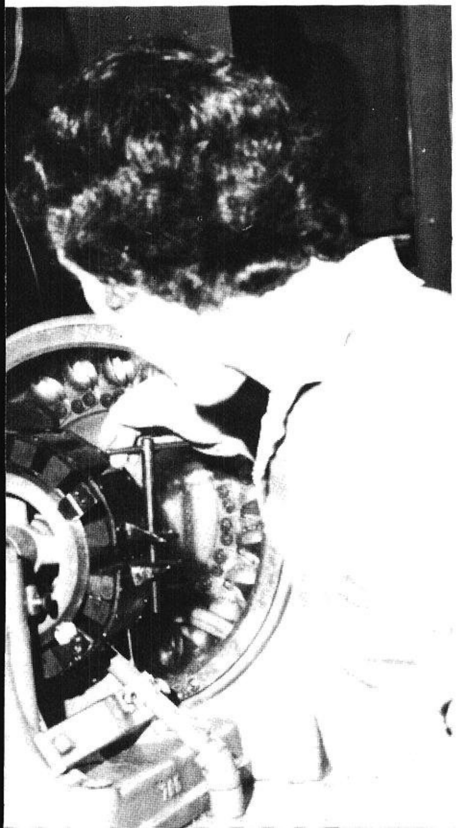












National Engineers Week, February 19-25, was set aside by the federal government as a time to honor the men and women who helped build the technology and economy of America into what it is today.

Here at the University of Wisconsin–Madison, Polygon and the College of Engineering annually observe Engineers Week by offering activities to spur interest and respect for today's engineer.

On Tuesday, February 21, Professor Harold Jebens, a faculty member of the University of Wisconsin–Platteville Civil Engineering Department, spoke before a large group of students, mainly engineers, at Union South. His presentation, "Space Colonization: The Next Step," colorfully illustrated the involvement of all types of engineers in the operation and design of an orbiting space colony. (See story on page 8.)

On February 22, the engineering campus hosted students from Wisconsin high schools. Demonstrations in each of the departments gave the students an opportunity to observe a wide variety of engineering research activities.

Photo by Dennis Hilgendorf

FACULTY SKETCH: Bela I. Sandor

DANCER, SCULPTOR, ATHLETE AND EM PROFESSOR

by Joanne Haas

A few integrity lines and a graying beard frame his face as he rests his chin in his palm and describes himself as an "arty" person. His interests include swimming, dancing, sculpturing, high-jumping, weightlifting, young people and—metal fatigue.

Professor Bela I. Sandor of the Engineering Mechanics Department has a varied biographical background as well.

In 1957, Sandor, the elder of two children, left his roots in Hungary and traveled to the United States to study engineering at the University of Illinois. After obtaining his bachelor's degree, he went to New Jersey where he concurrently worked for the Bell Telephone Laboratory and completed his master's degree at New York University. After three years on the east coast, he returned to Illinois for his doctorate. Wisconsin was the next step—Professor Sandor has been a UW-Madison engineering mechanics professor for the past ten years.

Teaching and research are two important influences on Professor Sandor's professional and personal philosophy.

"With an engineering background, you can become something other than an engineer: a lawyer, a political doctor, or a business leader. I think that more than half of the top executives and industrial architects, although they do not deal with engineering problems or attempt to solve them, have had their training in engineering," he explains.

Engineering basically teaches problem solving techniques, according to Sandor.

"Our lives are very complex in a technological society, so some technological training is very advantageous. We are dealing with cars, complex houses and appliances every day. With his training, an engineer would normally manage better than others."

Many engineering students do not realize that they can go on to other professions, Professor Sandor says. But those that do, generally meet with success.

"People who apply to law school have to take a Princeton test, which is nationally recognized. It so happens that engineers do very well on these tests. This may be because the legal profession deals with problem solving and logical procedures, so people with engineering training have an edge. I knew some students who did this, and they all did very well."

When he is not in the classroom, Professor Sandor is in the laboratory conducting research on metal fatigue, the subject of his Ph.D. work.

"Anything can be broken if a large enough force is applied to it. If it does not break when you apply a small force to it, but you repeat that force more than once and then it breaks, it is fatigued," he explains.

Applying temperature measurement techniques to materials as they deform is one of the many projects in which Sandor is involved.

Professor Bela I. Sandor

The temperature data is used as the basis for analyzing stresses of materials as they fatigue. One graduate and several undergraduate students are assisting him on the two-year old project.

In addition, Sandor has written a book, *Strength of Materials,* used in intermediate Engineering Mechanics courses. Recently published, it includes advanced fracture and fatigue theory.

Even though much of his day is devoted to research and instruction, a great deal of Sandor's time is taken up by face-to-face discussions that don't always deal with engineering.

"One of my hobbies is just dealing with young people," says the father of four girls. "A lot of students come to me for help about job choices, life goals, and technical advice."

Professor Sandor says he enjoys hearing students' ideas and attempting solutions to their problems.

The professor is also a student, himself. Some of his engineering students may have been surprised to see him on stage in "The Nutcracker" as one of the houseguests and as a highly energetic Russian dancer. He has appeared in several ballets, large and small, over the past five years. And although he has been taking ballet lessons for only five years, he is already at the ten-year ability level.

He takes two private lessons a week at the Madison School of Ballet, and has recently begun a modern dance class at the Kanopy Dance

Photos by Dennis Hilgendorf

SANDOR ISSUES CHALLENGE

"I'd like to issue a friendly challenge to any engineering student: I'll bet I can beat any student in two swimming races: a 50-yard breast stroke with my hands tied together and a 50-yard freestyle with my ankles tied together." Sink or swim . . .

Theater. He is not a professional dancer, but has shared the stage with many of them.

Engineering, Sandor says, plays a major role in his dance technique.

"Dance involves movement and stability and strength. So, understanding physical principles, which you learn in any undergraduate course, is useful.

"For example," he continues, "spinning and pirouettes (a rapid whirling about on the toes) are easier if you understand what you should be doing instead of just trying to go with a lot of practice and feel for it.

"I'm not saying it makes it terribly easy, because you still need the physical experience of doing it."

And it seems that Professor Sandor is almost as good with his hands as he is on his feet. About ten years ago, one piece of his sculpture was on display in the Brooklyn Museum in New York. He calls his sculpture a modest "dabbling in art," and he prefers the challenges in sports and dance.

When Sandor began dancing, he also started weight lifting and high jumping.

"Once I became interested in dance, I looked at the various research areas that are relevant to it, and studied things," he says. "I know a great deal about certain sports areas, and I apply those theories. I'm stronger now than I ever was before," asserts the engineer/dancer.

And as any dancer will tell you, ballet is the most demanding discipline of all.

Back in his college days, Sandor was a varsity team swimmer for the University of Illinois. He's in better shape than ever, he says, and issues a friendly competitive challenge:

"Later in the spring, I will challenge any engineering student in a swimming race."

He claims he hasn't been swimming regularly for a while—since last summer, in fact. And here is the catch: Professor Sandor will swim two races, a 50-yard breast stroke with his hands tied together and a 50-yard freestyle with his ankles tied together.

Any interested student should send his or her name and address to Professor Sandor and he will set the time and place. This should be something to see!

With a gleam in his eye, Sandor says, "Now I'm not going to wager that I'll win, but chances are . . ."

—Joanne Haas is a junior Journalism student. In addition to being Assistant Editor of the Wisconsin Engineer, she is Fine Arts Editor for the Badger Herald. Joanne hopes to pursue a career in magazine writing.

APPROPRIATE TECHNOLOGY:

A Sign of the Times

by Jon C. Sesso

Solar heat panels on condominium roofs, toilets that convert wastes to sanitary compost for the garden, backyard greenhouses where both plants and fish are raised for food under a system of intensive organic farming—these are all part of the new "appropriate technology" that is catching the imaginations of many Americans.

The term "intermediate" or "appropriate technology" was introduced several years ago by E. F. Schumacher, author of *Small is Beautiful.* Essentially, it means small-scale, energy efficient, decentralized ways of doing things.

Actually, appropriate technology is not such a new concept. The pioneers of the 1800s were a self-reliant group for whom the development of small-scale technologies was a folk art. These self-sufficient settlers depended on their own inventions and handiwork for their livelihoods. Their simple, efficient tools and machines aided them in tilling the soil and building homes for their families.

As America entered the Industrial Age, technology took on a new look. With an abundance of resources and cheap energy at hand, technology shifted toward mass production. Prefabrication, assembly lines and nationwide marketing networks replaced local self-sufficient systems. A technology based on high resource consumption developed in response to the demands of a changing society.

Today, however, Americans and the rest of the world face a dwindling supply of resources, and once again, appropriate technology is popular.

Appropriate technology is not easy to define these days, partly because it means different things to different people, and partly because it is a changing, growing concept. Basically, it centers on technologies that are simple and inexpensive to construct and maintain, and that require little energy to build and operate. These technologies are generally labor, rather than capital, intensive.

The main goal of appropriate technology is to enhance the self-reliance of people on a local level. This includes not only the design of mechanical systems, but also the development of cooperative systems of food marketing or small-scale manufacturing.

In one sense, everyone can be an "appropriate technologist." Some may simply walk or ride mass transit rather than drive a car. Others may install water-saving devices in their home or apartment, or use returnable beverage containers. And those who are more ambitious may even build their own solar heating systems.

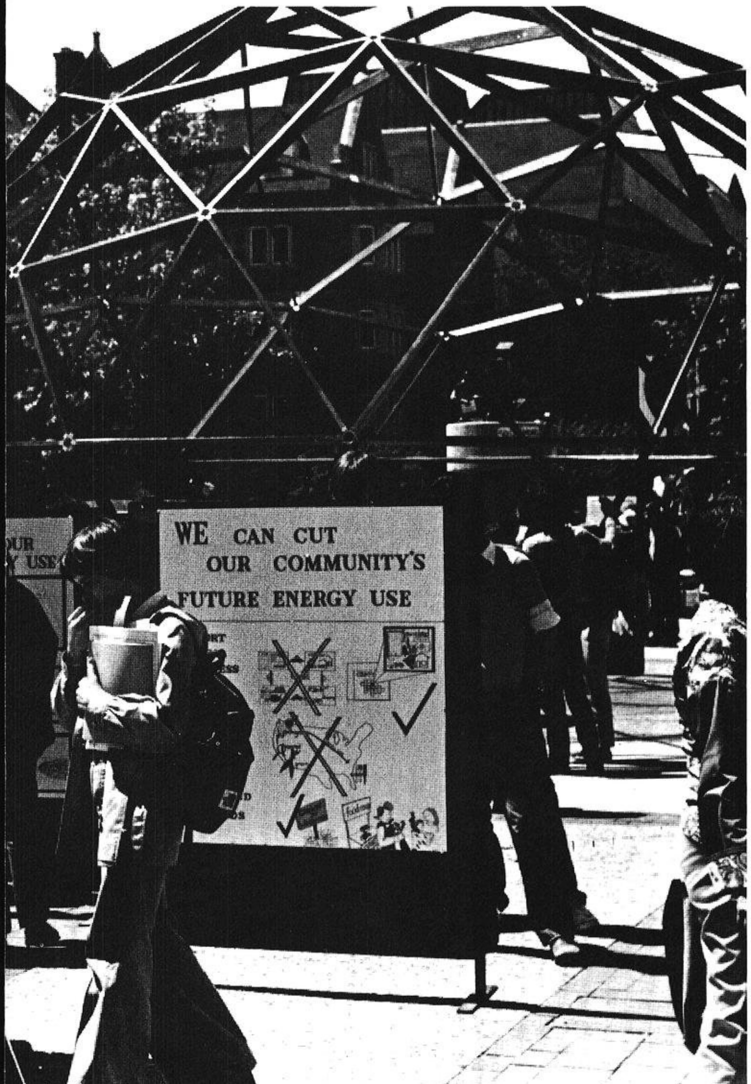
One obstacle that may stand in the way of appropriate technology is American attitudes. There is no guarantee that people will accept these cheaper and simpler, but sometimes less convenient, designs for living. To some, appropriate technology implies going backwards in time, regressing into the past.

But, appropriate technology has fostered a burst of creativity that has caused many others to think seriously about any number of small energy saving and producing activities, the cumulative contribution of which can be large.

Alternative energy technologies aren't available for everyone, to be sure. They require some cleverness, an understanding of energy, time and money. For those who want to learn more about appropriate technology and its proper role in society, the second annual Alternative Festival is a place to start.

All festival events will be held in Madison on Saturday, May 6. An exhibit fair will be located on State Street Mall while workshops and panel discussions run concurrently in the Memorial Union and State Historical Society.

Last year's Alternative Festival provided visible evidence of the public interest in appropriate technol-



The Alternative Festival will be held on May 6 from 11 a.m. to 6 p.m. on the State Street Mall. Exhibits from last year's Festival included two features from Expo '77 (above): the solar grain dryer and the bicycle built for two.

Photos by Jon Sesso.

ogy. An estimated 5000 people came to see the solar collectors, wood stoves and windmills displayed on the mall. The hardware will be in evidence again this year, with exhibitors demonstrating both commercially available and do-it-yourself devices. There will also be informational exhibits presented by local organizations, University departments and governmental agencies. Theatrical troupes, musicians and jugglers may also be in attendance to add to the festive atmosphere.

Workshops will be both technical and philosophical. Topics will range from passive approaches to solar heating and building codes that constrain the use of alternatives, to a critical overview of appropriate technology as it relates to human values.

The second annual Alternative Festival is being held in conjunction with "Sun Day," (actually Wednesday, May 3), a national movement to promote the benefits of solar energy. The Festival is being sponsored by a variety of student and community organizations, most notably the Wisconsin Union Ideas and Issues Committee and the Center for Community Technology.

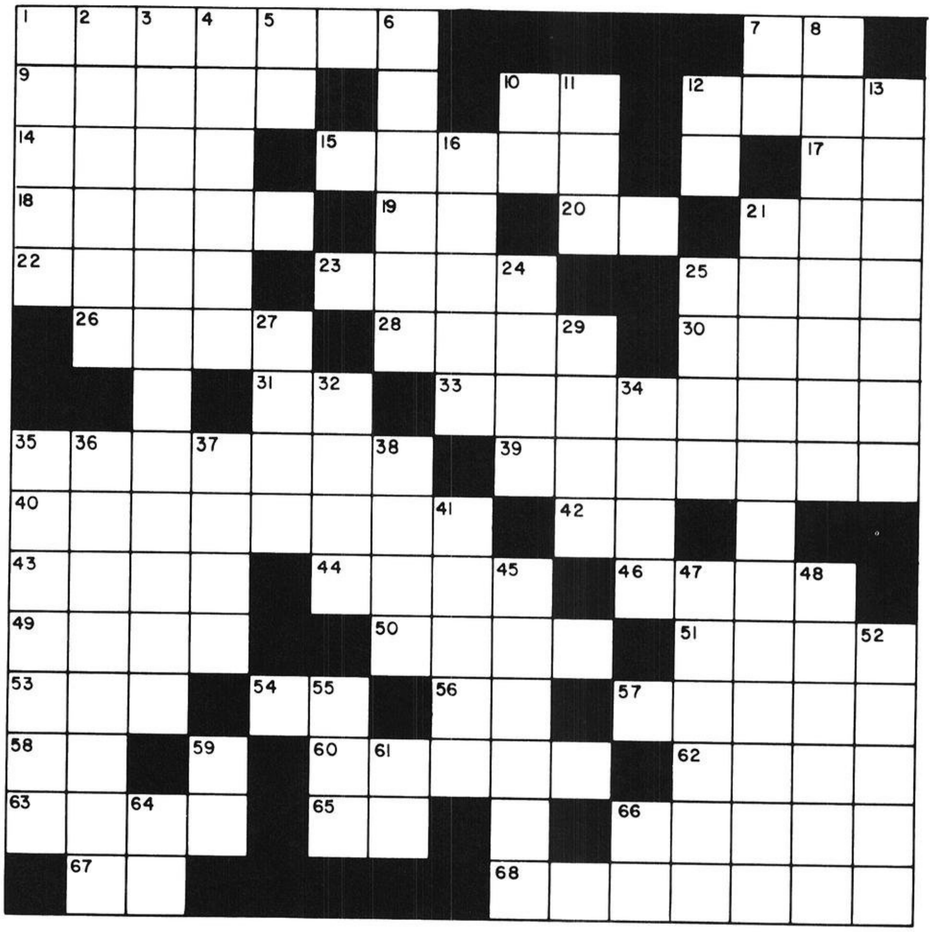
The purpose of the festival is to help people realize that specific applications of appropriate technology can save money, conserve natural resources, and even make life more pleasant.

Engineers especially must take a critical look at alternative technology ideas and use their insight to evaluate the feasibility of these ideas in today's society. From there, engineers can play a key role in the proper development of appropriate technology for the benefit of society.

At the core of many appropriate technology ideas are two very old American virtues, self-sufficiency and self-reliance. In the not-too-distant future, such virtues may again be predominant. And appropriate technology may become a prerequisite to our survival.

—Jon Sesso is in his final semester of graduate school. He is pursuing a degree in Environmental Communications.

ENGINEER'S CROSSWORD PUZZLE



ACROSS

1. Thermodynamic Cycle
7. Idiot Box (abbr.)
9. Receiver of E.M. Waves
10. Exist
12. Washing Agent
14. Engineering Organization
15. "_____ Ye Land Lubber"
17. Model Plane Controls (abbr.)
18. One Who Acts as a Decoy
19. Male Nickname
20. Current (abbr.)
21. Lubricant
22. Transmit
23. Boorish person
25. "__ __ Can You See . . ."
26. To Take the Chance Of
28. Polluted Fog
30. Strategic Weapon
31. Department of College of Engineering
33. Tributary to Nile
35. Fall Back
39. Football Player
40. Resident of France or Italy, for example
42. Greek Letter
43. Piece of Data (slang, abbr.)
44. Smelting Refuse
46. Blood Type (abbr.)
49. Man's nickname
50. Miss Gabor's
51. United States Naval Force (abbr.)
53. Solid Liquid
54. While
56. Chemical Symbol
57. Aluminum Co.
58. Ambient Temperature (abbr.)
60. Public Walks
62. Girl's Name
63. Indefinite Article (Germ.)
65. Part of Subconscious
66. Person With Skin Disease
67. California (abbr.)
68. Golf Club (Pl.)

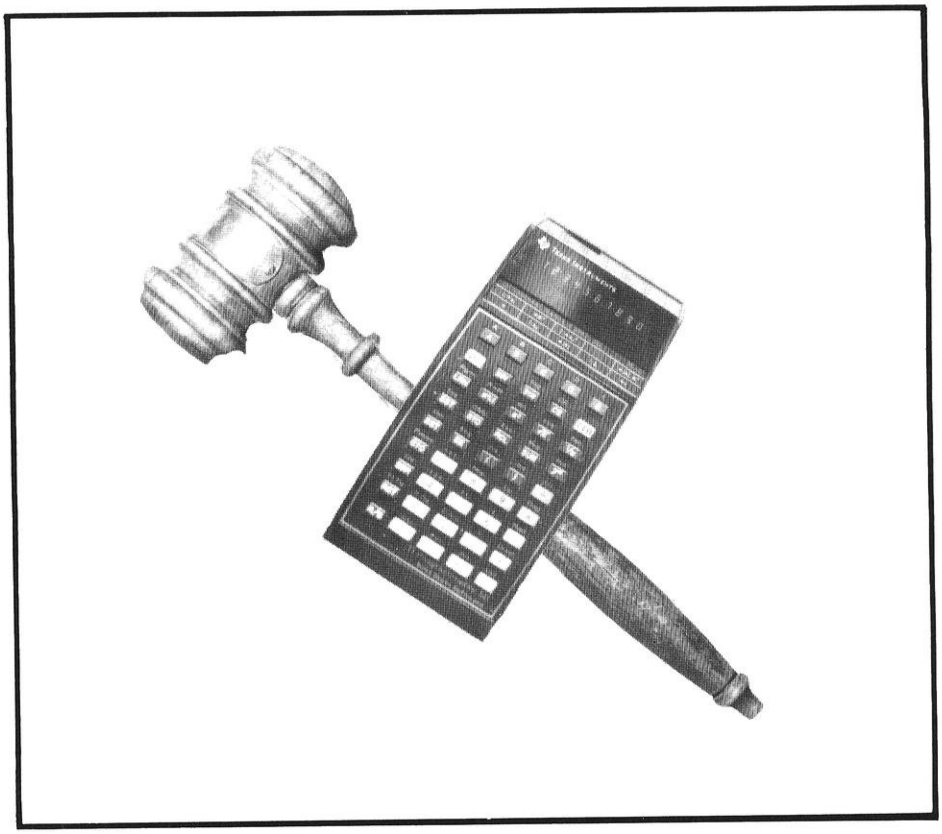
Puzzle answer on page 28.

DOWN

1. Alloy
2. Hastier
3. To Direct
4. Gives Way
5. Preposition
6. Oranges
7. Toward
8. Not constant
10. Degree (abbr.)
11. Arrival Time (abbr.)
12. Chemical Symbol
13. Plastic
16. War Weapon
21. Electrical Measuring Device
24. Fastener
25. Pig Noise
27. Retain
29. South Pacific Isle
32. Miss West's
34. South American Country (abbr.)
35. Breathe
36. Equilibrium Transition Temperature
37. Soccer Player
38. Story
41. Pertaining to the Navy
45. Pollster
47. Chicken
48. Noisy Sleeper
52. Expositions
55. Building Across From Sterling Hall
59. Type of Engineer (abbr.)
64. Sodium
66. Not Dark (abbr.)

–Crossword Puzzle designed and composed by Pat Gureski and Jerome Davis

ENGINEERING LINKED TO LAW



by Donald H. Slavik

Engineering and the law. Some students believe that there couldn't be two more dissimilar areas of study. Most engineering students have little or no contact with those "cane-carrying folks" (to quote a former roommate) on the Hill. Granted, both the lawyer and the engineer are described as "professionals," but what other considerations link these two fields, one seemingly ambiguous and the other very precise?

A glance at the headlines in any major newspaper provides some clues:

YOUTH WINS $128 MILLION IN DAMAGES

PARENTS GET $2.5 MILLION IN CRASH BLAST

JURY SAYS FORD MUST LIVE UP TO TRUCK AD

$1.5 MILLION AWARDED FOR ACCIDENT INJURIES

These are just a few of the cases in today's courts that involve the engineering field to a substantial degree. We can break down the possible interactions between lawyer and engineer into at least three areas: products liability, contracts, and patents.

The problem of products liability is a recent development in the law of torts (civil wrongs). The law dictates that a "manufacturer is strictly liable in tort when an article he places in the market, knowing that it is to be used without inspection for defects, proves to have a defect that causes injury to a human being. In simple terms, this means that a manufacturer is liable for injuries caused by a product which he sells that was defective, whether or not he knew it to be so.

In 1965, the average award received by a plaintiff in a products liability settlement was $11,644. By 1973, this amount rose to $79,940.

Here in Madison in February of 1978, an Indiana bakery worker was awarded $1.5 million for injuries he suffered from falling through a skylight on the roof of a building. Both the manufacturer of the skylight and that of the building were found negligent.

Auto manufacturers have been losing numerous suits filed due to injuries caused by the faulty design of fuel tanks. In a suit in California, a youth was awarded $128 million, perhaps the largest sum ever granted in a products liability case.

But what does a practicing engineer have to do with such legalities? Just this: an engineer was probably responsible for the design of the device, and thus at least partially responsible for its "defectiveness."

Nowadays, a designer must do all that is humanly possible to make his product safe to use. Disconnectable switches, safety shields on lawnmowers, fuel cells in automotive gas tanks, and warning labels on electrical equipment are just a few examples of engineered safeguards. All engineers involved in the design of commercial products, from farm tractors to pipecutters, must be aware of products liability law.

Another meeting ground for lawyers and engineers is the area of contracts. A contract is a promise, or set of promises, for breach of which gives a remedy, or the performance of which the law in some way recognizes as a duty. Contracts between buyers and sellers of goods and services are drawn up every day across the nation.

The inability to perform the work specified in a contract will often lead to a suit filed in court to recover damages, and/or have the contract enforced in favor of the injured party.

An example of this was the suit filed by several Eastern power utilities against a nuclear fuel fabricator. The fabricator was unable to furnish the fuel at the contracted prices due to an increase in costs, and the utilities ended up winning a substantial settlement.

Occasionally, if a party finds that it cannot fulfill its part in a contract due to actions beyond its control, it may have to petition the courts to have the pact waived. It is not uncommon for a field engineer to become involved when the company lawyers come around asking why the contract cannot be kept from a practical standpoint.

A third legal subject of interest to the engineer is patent law. A patent is a government grant to an inventor, his heirs of assigns, for a stated period of time, conferring on him a monopoly of the exclusive right to make, use and vend the invention or discovery.

Most manufacturers hold one or more patents on their products. Every industrial technological innovation today is patented.

The patenting of a product or process is a fairly complicated task, requiring the services of a lawyer specially trained in patent law. First, the lawyer conducts a patent search to see if anyone else already holds a patent on the proposed idea. If not, s/he files a patent application. Several more steps are then taken before a patent is issued. The important point to notice here is that a patent is a legal process, involving both the lawyer and engineer.

Engineering students here at the UW have at least two good opportunities to learn about engineering and the law while earning credit. One is by enrolling in Professor Richard A. Moll's course "Products Liability", (Metallurgical and Mineral Engineering 469). This is an excellent introduction to the legal problems that confront working engineers in the field of products liability. The other course is Professor R. J. Smith's "Legal Aspects of Engineering" (Civil and Environmental Engineering 491). This course focuses upon contract preparation and patents.

For engineers who are interested in learning more about the law, there is the opportunity to actually enroll in Law School and obtain a J.D. degree, Doctor of Law.

To apply to the UW Law School, a student must obtain an application form in room 232 Law. This form must be filed along with an application fee of $20 by February 15 of the year the student wishes to enter.

Students with an engineering undergraduate degree usually do very well in Law School because they already possess the "mental toughness" required.

We are often told that as engineers, we must have a broad educational base from which to work. Knowledge of the law and how it particularly affects engineers is becoming an increasingly important professional tool.

—Don Slavik is a senior Nuclear Engineering student. He wants to pursue a career linking engineering and law.

LIVES AT STAKE:
MATERIALS USED IN ARTIFICIAL ORGANS

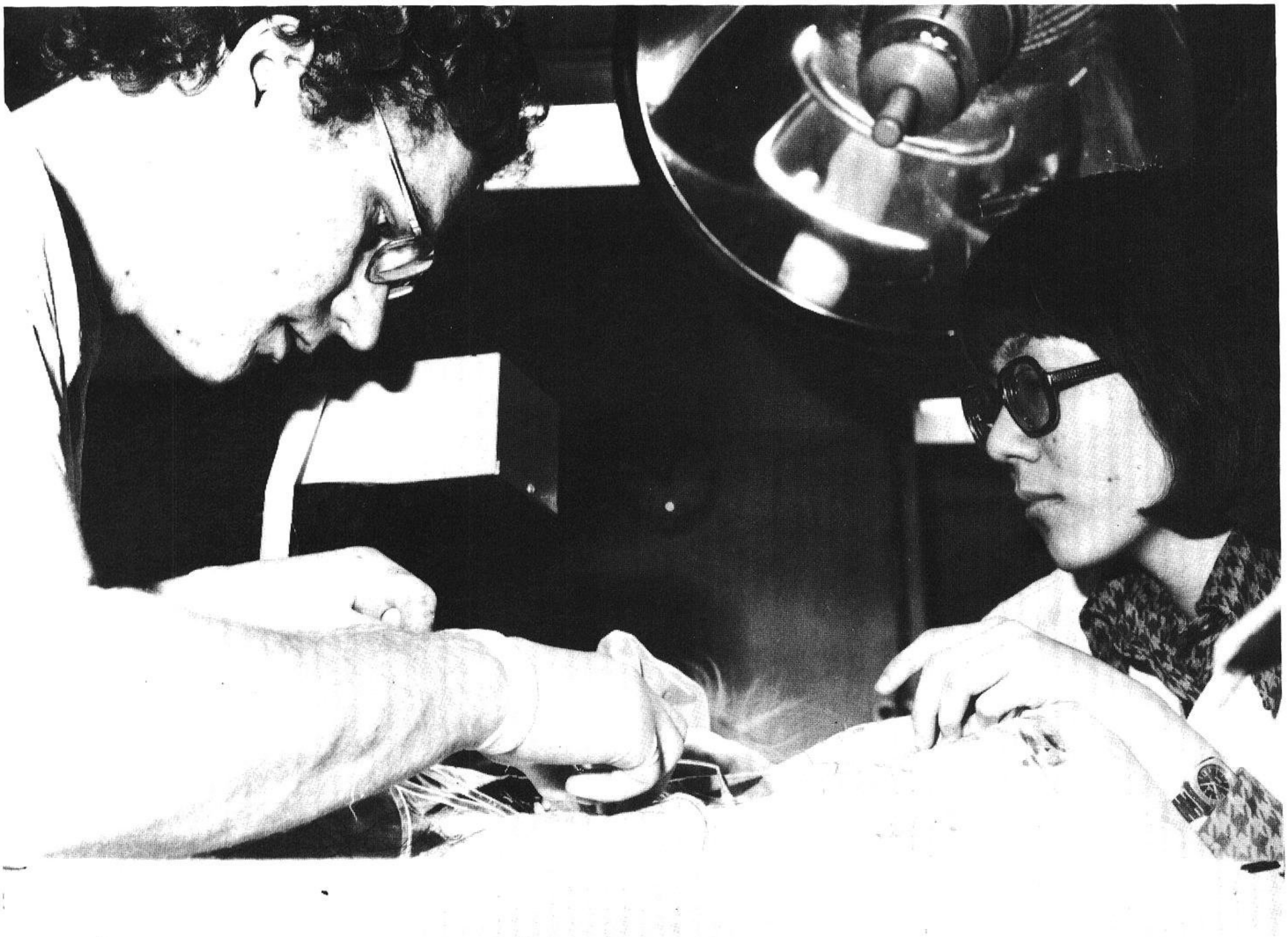


Photo by Dennis Hilgendorf

Tim Mathis and Sophia Tsang perform surgery on a canine specimen. They are testing various materials used for artificial organs.

by Tim Mathis

This year more than 500,000 people (three times the population of Madison) will die from heart disease. Many more lives will be affected by kidney disorders and broken bones.

What do heart disease, kidney disorders and broken bones have in common? They are all medical problems which could be solved if suitable artificial organs or devices were available.

Much has recently been accomplished in the development of artificial devices: kidney dialysis is common; mechanical heart valves are available; metal pins and braces strengthen bones; and silicone rubber is used in plastic surgery.

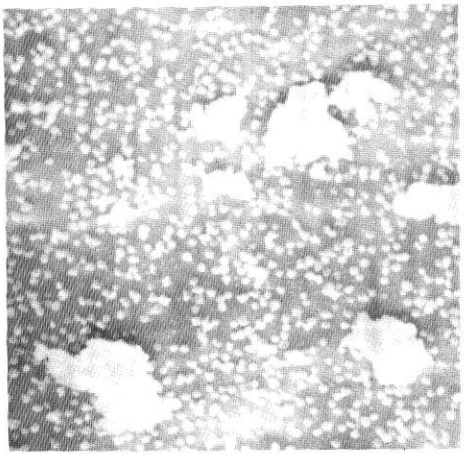
The problems in finding a suitable material to construct an artificial device are tremendous. In the Department of Chemical Engineering, Professor Stuart L. Cooper is conducting research on a wide variety of materials which must meet the exacting mechanical and physical standards required of an artificial device to be used in the body.

An artificial heart, for example, must be able to flex a half-billion times in ten years. And the membrane used in an artificial lung must be permeable to oxygen and carbon dioxide.

In addition to these constraints, all materials for internal use must be inert in the body. They cannot be degradable, toxic, carcinogenic, or inflammatory.

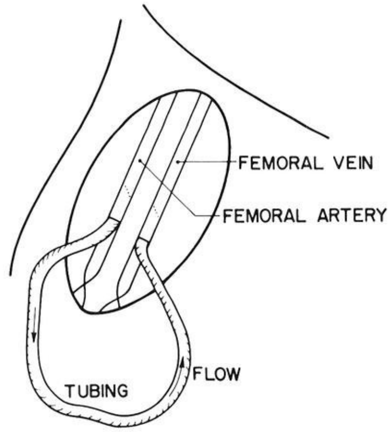
If that seems like a tall order, there's also the crucial problem of developing materials that are compatible with blood. When blood contacts a foreign surface, thrombi, or blood clots, develop on the surface, and impede or stop the flow of blood.

If thrombi break loose from the

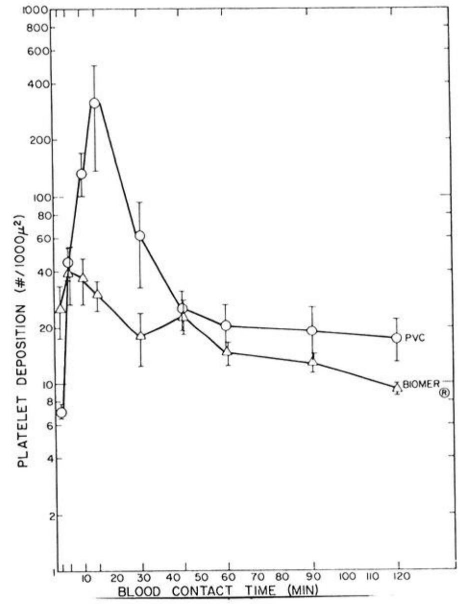


Low magnification (500x) of singly adhered platelets and of larger thrombi, on a surface of poly (vinyl chloride).

Higher magnification (3000x) of platelets adhered to a layer of adsorbed proteins. The material is poly (vinyl chloride).



A length of tubing is connected to the femoral artery and vein of the leg.



Graph of amount of thrombus versus time for two materials: poly (vinyl chloride) and Biomer.

surface, they flow with the blood until caught in small capillary vessels, where they plug the flow of blood and damage nearby oxygen-starved tissues.

The search for nonthrombogenic materials is an important and difficult challenge for the materials engineer. Many materials are being tested in an attempt to discover which of their properties causes the coagulation of blood.

Studies have shown that an adsorbed protein layer affects the amount of thrombus formation. When blood contacts a foreign surface, plasma proteins are immediately adsorbed to the surface. Platelets, special blood cells for clotting, adhere to the adsorbed proteins and initiate clotting and thrombus formation.

Different materials adsorb different proteins from the blood. Some plasma proteins are thrombogenic, such as fibrinogen and gamma globulin. However, if albumin is predominantly adsorbed, the material is invariably non-clotting or thrombo resistant.

When designing new blood compatible materials, it is therefore desirable to have more adsorbed albumin than fibrinogen and gamma globulin.

Much has been learned from this research, but many questions remain unanswered. In an attempt to solve the puzzle, UW researchers have developed a procedure for testing materials in live animals.

In the experiment a canine subject is anesthetized, and a length of tubing is connected to the femoral artery and vein of the leg, so that the blood flows from the artery, through the tubing, and back into the vein. The number of adhered thrombi is determined by "tagging" the components of a thrombus (platelets and fibrin) with radioactive materials, and measuring the amount of radioactivity in the tubing.

The results of these experiments have shown that on most materials the thrombi build up rapidly, reaching a maximum in about fifteen minutes. The rapid accumulation of thrombi indicates the material is thrombogenic, since it has strongly activated the clotting system. Any rapid decrease in thrombi is another undesirable quality, since it shows thrombi have been washed off, and are circulating in the blood causing damage to tissues throughout the body.

The perfect material has yet to be discovered, but tests such as those being conducted here at UW–Madison may well provide some important clues to the mystery of the body's acceptance or rejection of artificial materials.

—Tim Mathis is a graduate student in Chemical Engineering. He is currently involved in research dealing with the use of materials for artificial organs.

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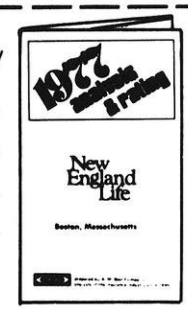

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- Copier-duplicators and sensitized products that make the distribution of information on paper much simpler than it used to be.
- Simple, quick, low-cost ways of retrieving microfilm images bearing detail too voluminous to keep on paper.
- An extension of certain special technologies of ours far beyond the image business to the even more vital business of blood chemistry.
- New knowledge about dyes and fibers, which molecules cling to which and what they do to light.
- New environmentally acceptable solvents which help customers formulate coatings that meet stringent air-pollution standards.

In explaining our game plan on such matters, we stress one theme that connects everything together: **recognizably distinct quality.** The world does recognize Kodak quality, and we need very good engineers to provide it at a price the world can afford to pay.

If you are confident you will turn into a very, very good chemical, mechanical, electrical, or industrial engineer, and would like a chance to plot your own growth in a major league, begin by telling us what makes you confident. Tell Business and Technical Personnel, Kodak, Rochester, N.Y. 14650.

Kodak

An equal-opportunity employer (f/m) manufacturing photographic products, fibers, plastics, and chemicals with plants in Rochester, N.Y., Kingsport, Tenn., Windsor, Colo., Longview, Tex., Columbia, S.C., Batesville, Ark., and a sales force all over the U.S.A.

We're looking for engineers who can't wait to get to work.

We're looking for people who are looking for a real job. One that offers challenging work. Responsible work.

That's what you can expect at General Electric.

At GE, you'll be handed important assignments right from the start. You can do as much of the job as you're capable of doing. If you need help, it's there. If not, nobody butts in.

Here's the kind of thing we're talking about; some recent examples of jobs handled by new GE engineers:

1. *Charles P.* Aerospace systems manufacturing. Develop and document a direct numerical control system.
2. *Steve O.* Design engineering. Design test equipment for attitude control system of new communications satellite.
3. *Norma L.* Steam-turbine manufacturing. Investigate, analyze and obtain funds for solution of shop problems.
4. *Stephanie B.* Medical systems service engineering. Installation and test of new hospital radiographic and fluoroscopic x-ray system.
5. *Mel D.* Field engineering. Appraisal load testing of low and medium-voltage switchgear and power transformers for utility and industrial applications.

There's a good reason GE hands people like that—like you—real work assignments. It's the best way to develop the skills you will need throughout your career. You develop initiative and creativity. And responsibility. And GE also knows there's little to match the glow you feel when you make an important contribution.

You can make your contribution in just about any field of engineering at GE. We're that diversified in disciplines.

If you like the kind of challenge and responsibility that GE offers, we'd like to hear from you. Send for our free careers booklet. Just write:
General Electric, Educational Communications, WID, Fairfield, Connecticut 06431.

Progress for People

GENERAL ELECTRIC

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