Wisconsin engineer. Volume 90, No. 4 April 1986

Madison, Wisconsin: Wisconsin Engineering Journal Association, [s.d.]

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Volume 90 No. 4

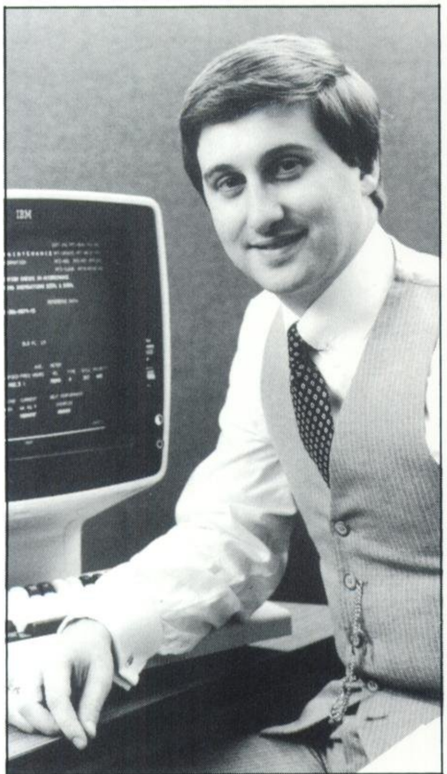
APRIL 1986

wisconsin engineer

RESEARCH
In the College of Engineering

- Vocal Deformities
- Strategic Defense Initiative
- Wisconsin Cheese

Follow In Their Footsteps



After graduation, you will want to use your knowledge, skills and creativity in an organization that will provide opportunity for personal growth and advancement.

Oscar Mayer Foods Corporation, the leading meat processing company in the U.S., has such positions for talented young people. We need good engineers to develop better production machinery, improve our maintenance administration, help manage our plants, and to work in the many diverse engineering jobs that are so vital to our company. The young engineers featured on this page have found rewarding careers in keeping us No. 1 in our industry. We will continue to need good young engineers to follow in their footsteps as they advance through our organization. You could be one of them.

P. J. Samson
Plant Engineering Manager
Los Angeles Oscar Mayer Plant

P.J. *graduated in May 1979 from the Illinois Institute of Technology with a B.S. degree in Mechanical Engineering and entered our six month Engineering Management Development Program.*

P.J. has held a variety of positions in Maintenance Administration and Maintenance Supervision. In addition to these plant assignments, P.J. also works on our Corporate Engineering Staff in implementing an in-house designed, on-line computerized maintenance management system.

P.J.'s most recent assignment is at our Los Angeles plant as Plant Engineering Manager. In this position, he is responsible for all engineering, maintenance and powerhouse activities at this location.

Oscar Mayer

Oscar Mayer Foods Corp.
Corporate Recruiting Office
P.O. Box 7188
Madison, Wisconsin
1-608-241-6897

Pat Molitor
Plant Engineering Manager
Davenport Oscar Mayer Plant

P*at started with the company in June, 1977, after obtaining a B.S. in Civil Engineering from the University of Wisconsin. He entered our six month Engineering Management Development program which provides the new engineer with a broad overview of the opportunities in the Engineering Division. The program also points out the significant role that the Engineering Division plays in the overall structure of the Oscar Mayer Foods Corporation.*

Pat has held various positions of increasing responsibility in the Maintenance Administration and Maintenance Supervision since graduating from the EMDP program. Pat's most recent assignment is Plant Engineering Manager at our Davenport facility. In this position, he is responsible for all engineering, maintenance and powerhouse activities at this location.

wisconsin engineer

PUBLISHED BY THE ENGINEERING STUDENTS OF THE UNIVERSITY OF WISCONSIN-MADISON APRIL 1986

COLUMNS

RESEARCH FEATURES

ADDITIONAL FEATURES

Board of Directors: Michael Corradini, Gerald Duchon, Ed Kuipers, Evelyn Malkus, Richard Moll, Tom Murray. **Faculty Advisor:** Don Woolston.

The **Wisconsin Engineer Magazine** is published by and for engineering students at UW-Madison. Philosophies and opinions expressed in this magazine do not neccessarily reflect those of the College of Engineering. All interested students have an egual opportunity to contribute to this publication. **Charter Member of the Engineering College Magazines Associated. Chairperson:** John N. Clausen, Mechanical Engineering Building, University of Minnesota, Minneapolis, MN 55455.**Publisher's Representatives:** Littell-Murray-Barnhill, Inc.,1328 Broadway, New York,NY 10001 and 221 North LaSelle Street, Chicago, IL 60601.**Publisher:** Community Publications.

Correspondence: Wisconsin Engineer Magazine, Mechanical Engineering Building, 1537 University Avenue, Madison, WI 53706. **Telephone:** (608)262-3494.

Published five times yearly: October, December, February, April and June by the Wisconsin Engineering Journal Association. **Subscription:** one year - $10.00.

Too much emphasis on GPAs?

Editorial

by Clement Audu

The goals of many students are achieving a high GPA, getting accepted in the engineering department of their choice, maintaining high GPAs through school and ultimately obtaining that great high- paying job with a prestigious company.

The overemphasis placed on high GPAs detracts from our very purpose in enrolling in the engineering college. We are here to acquire the skills and knowledge to be good engineers, to learn to make value judgements, and apply the course materials we learn to real-life problems.

Many students are in a constant battle to raise and maintain their GPAs at a reasonably high level. To achieve this, many students sacrifice learning and understanding course materials for cramming nights before an exam only to forget the materials a little while after the exam. They might get high grades for their study strategies, but is that an indication of what they really know? Real knowledge and understanding is flexible, can be applied in varying situations with sound judgement, and very much remains with time. This is what we should be striving for because it is the reason we are here in the first place. If we cannot have an understanding of engineering problems from an academic as well as from a practical perspective, then of what value will our degrees be?

Some of you might be aware of that student in your classes who always asks insightful questions, appears to have a good understanding of what is going on, engages in academic and practical debates with the professors and occasionally helps explain course materials to you out of class. But then comes the exam and maybe he/she gets a lower grade than you or a grade not reflective of what he/she really knows. Then there are those who do well on hourly exams; some are knowledgeable of the materials and others have simply crammed. Exams, in reality, are not a true measure of one's abilities and skills, but simply a measure of exam-taking skills. People respond differently to pressure. How one responds to pressure is not indicative of that person's abilities and skills in a particular area; it only indicates how resistant to pressure that person is.

Who is responsible for this emphasis on grades -- students, teachers or the administration? Students for the most part can be relieved of the blame since they only respond to the dictates of teachers and the administration. They have to obtain a certain GPA to be accepted into the department of their choice, they have to maintain a satisfactory GPA to remain enrolled and ultimately they need a good grades to obtain their desired jobs. The teachers, at least some of them, agree that grades are not a true measure of one's skills and abilities, but are quick to add that it is only the system available for them to rate students. Moreover, the administration requires grading and the professors have to comply with administration requirements. I suppose the system is to blame.

Professors can help improve the situation if they place more emphasis on class participation when determining final grades, so as to take the pressure off of exams. The administration could institute a policy whereby each student is required to work in a company related to his/her major for at least one semester; the employer would be asked to grade the individual student based on his/her performance on the job. The combination of on-the-job and classroom grades will then provide a more objective rating for a student than classroom grades alone. If the goal of most students is to work in industry, should they not be graded in conditions similar to those in which they plan to work? Performance on the job is not based on a series of one-hour exams, but on insight, creativity, professional judgement and problem-solving skills. These are the qualities that engineering schools should strive to promote among their students. When this is finally achieved, students with more practical experience and abilities will have the chance to prove themselves.

Dean's Corner

Research funding: Where does it come from?

by John G. Bollinger

I welcome this opportunity to give my perspective on the role of research in our college.

Sometimes people who do not understand the university tell us to do less research and more teaching. In fact, the two are inseparable.

Here are some important characteristics of our research programs:

-- Our research funds are raised by faculty initiative. In fiscal 1984-85, we had a total college budget of nearly $38 million, including more than $22 million for research. About 58 percent of that came from federal agencies and another 24 percent came from industry, foundations, and individuals -- mostly from industry. We received these funds, about $18 million in all, because faculty members wrote proposals and won research contracts.

A federal agency or a company will support the engineers and scientists who it believes can produce the best results. In other words, our faculty members compete with their colleagues across the nation. It is a mark of their success (and thus of their quality) that in fiscal 1984-85, this college ranked ninth nationally in engineering college research budgets. Only about 23 percent of our total college budget (covering all research, teaching and other activities) comes from state tax dollars.

--Research is an essential part of graduate education. Some of the research funds our faculty members obtain go directly for graduate student support. Essentially all research in the college involves graduate students, and graduate student theses are a major part of the research process. Graduate students thus are able to work on real-world problems of interest to industry and government, and often have access to complex equipment donated by industry. By the way, contrary to popular belief, when a faculty member wins a grant, he cannot use that money to increase his own salary. Salaries are set by a process involving the department, faculty, the college administration, and the university no matter what the source of the funds.

--Research benefits undergraduate education. Some people claim there is a tension between research and undergraduate teaching, but I have always found that the work my graduate students and I did was essential to the information I presented in undergraduate classrooms. Professors who work with industry and government on current problems have much to offer undergraduates who will soon go to work for those organizations.

These are tough times for our college. Many of you know that the state budget was cut his past winter, and a portion of those cuts fell on us. New federal budget developments will also seriously affect us.

Many agencies simply will not have as much money to grant as in the past. Because of our high-quality faculty we will fare better than many schools, but we still will be hurt.

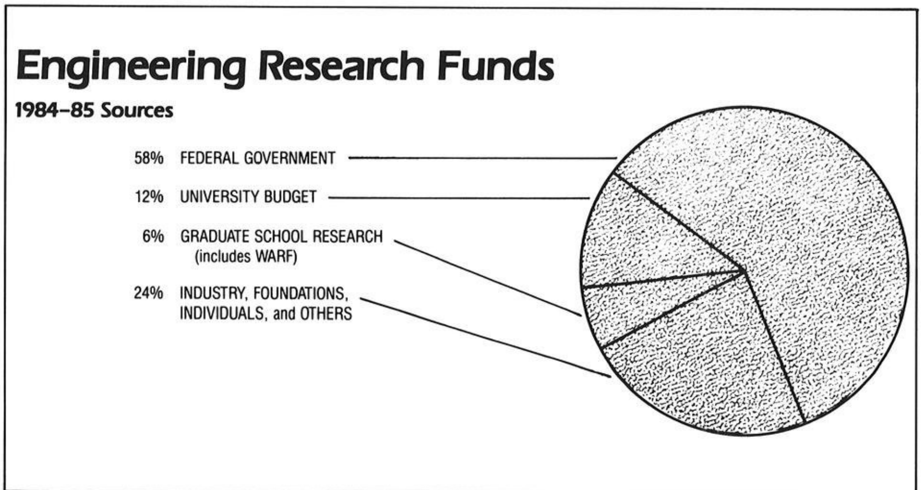
WE Photo Library

Dean John G. Bollinger

Certainly some faculty members will apply to more agencies for funds than they did in the past. For example, our superconducting energy storage program recently received a $682,000 "Star Wars" grant to continue its work. The program's research could have many applications in civilian life, but it is also obviously of military interest. The continuing university and college rule for such research is that it cannot be classified -- the faculty must be able to publish research results.

The budget cuts will have additional impacts. Generally the university and our college receive overhead funding when a faculty member wins a research grant. This helps pay costs associated with operating buildings, administering programs, and so on. It appears we may lose a substantial part of that overhead funding. This will mean our faculty and administration will have to work harder to maintain quality throughout our departments and programs.

One last point: our College of Engineering is part of a university which ranks third nationally in total research funding. We have high-quality faculty in many other areas at UW-Madison and they are successful in competition for funding. This collection of excellence across a broad range of fields makes this the great university it is -- for research and teaching, for students and faculty. □



Surface Mount Technology
Building better integrated circuits

by Jeff Molter

The Electronics Packaging and Interconnection Program (EPIP) is a very unique research program taking place at the University of Wisconsin. It is a collaboration between the UW-College of Engineering and American Electronics Manufacturers. EPIP will assist American industry in developing new and more efficient ways of housing and connecting integrated circuits.

Surface mounting technology will help make products that have more function features, are reduced in size, and are less costly.

The standard integrated circuit package for the last 20 years has been the dual in-line package (DIP). The DIP is a rectangular-shaped plastic housing with two rows of metal leads protruding from each side. The integrated circuit is protected from the environment by this housing, and is connected to the printed circuit board via the metal leads. This type of package is in the process of being phased out, because it can not handle the very large-scale integrated (VLSI) circuit chips that are needed for today's state-of-the-art technology. VLSI chips can carry up to 300 leads, while the most a DIP can accommodate is 64. Therefore, new and innovative types of packaging must be designed. EPIP will research and develop the new technology needed for these new packages.

Seven years ago in Japan, electronics manufacturers first began to mount miniaturized components directly on the surfaces of printed circuit boards. Surface mounting has since been able to meet the demands required of VLSI chips. Surface mounting technology (SMT) has provided Japanese products with many advantages, such as reduced cost, increased function features, and reduced size and weight, over similar American-made products. To help counteract this Japanese product advantage, the UW College of Engineering has proposed that the University and high-tech industry sponsors approach this problem collectively.

This program was initially proposed in 1985 and is just now being implemented. During its initial stages, 25 U.S. manufacturers of electronics equipment were contacted as possible sponsors. On January 8, 1986, an SMT-Interconnection Technology workshop was held here at the university with participants from AT&T, Bell Labs, Delco Electronics, General Electric, Honeywell, IBM, Motorola, Rockwell International, Xerox, 3M, North American Phillips, Nicolet Instrument, Northern Telecom, Allen-Bradley, and Cincinnati Microwave. Most of the necessary funding for EPIP will come from these companies. A few companies that did not attend the workshop, such as Hewlett Packard, have also expressed interest in participating in EPIP.

Currently, the program is coordinated by Dr. L. Ken Keys, the director of the UW Instrumentation Systems Center. There is also an executive committee of UW faculty members: Y. Austin Chang, Camden A. Coberly, Marvin DeVries, Henry Guckel, Robert Lorenz, Jerry Sanders, Bela Sandor, John Uicker and John Wiley will participate on this committee with Dr. Keys. The executive committee will develop plans and funding policies and will define the research direction of the program. Through Keys their ideas will be presented to the industry sponsors, who will also have input into EPIP. Final decisions on expenditures, overall program policies, research, project topics, and day-to-day operations will be made by Dr. Keys with the counsel of the Executive committee.

EPIP will assist American industry in developing new and more efficient ways of housing and connecting integrated circuits.

One of the major advantages of a research program such as EPIP is the collaboration between a number of different departments and laboratories within the Engineering School. The Instrumentation Systems Center is the hub of the entire technical portion of the program. It occupies a large portion of the seventh and eighth floors of the ERB. This is where the circuit design, analysis, development, and prototype fabrication for EPIP take place. There are six separate laboratories involved with EPIP:

-Instrumentation Systems Center SMT/ Interconnection Laboratory

-Engineering Mechanics Micromechanics and Fatigue Laboratory

-Metallurgical Engineering Solder/ Materials Joining Laboratory

-Materials Science Center Surface Analysis Laboratory

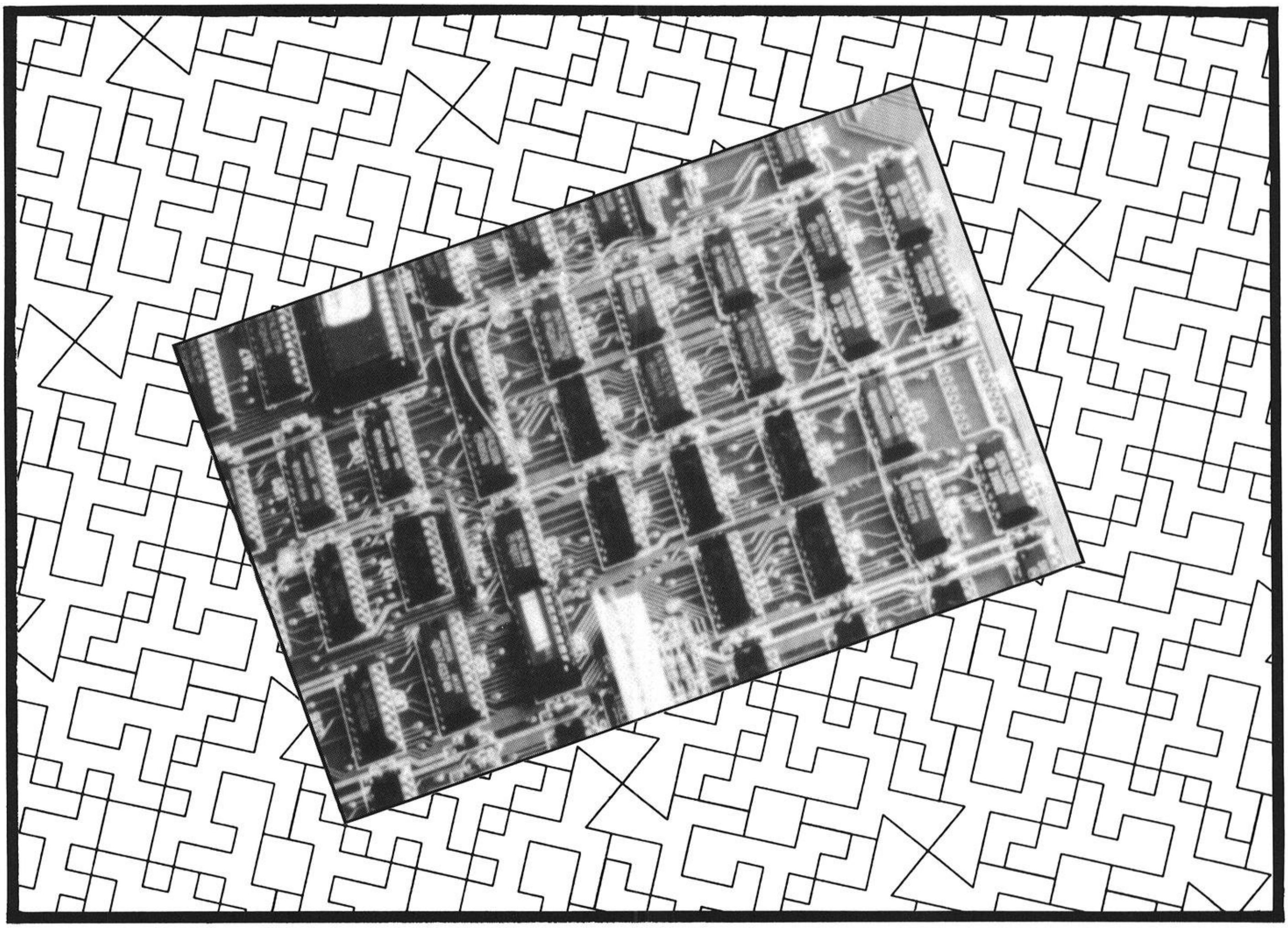
-Advanced Automation and Robotics Laboratory

-Industrial Engineering Manufacturing Process Modeling Laboratory

Currently, a six-member team of Manufacturing Systems graduate students is cooperating on a project that typifies the interdisciplinary flavor of EPIP. The team is developing a pilot production line designed to turn out SMT circuit boards. As part of ME 601, Industry Projects, these students are creating an industrial manufacturing atmosphere and cooperating to solve all logistical problems behind producing circuit boards with the new technology. Because three of the six team members are on leave from industrial positions, the team has no difficulty simulating reality, including realistically complex problems and concern for efficiency. According to team leader Kirk Berridge, "We've had some success already. We've taken demonstration boards and test components through to completion. Knowledge of computer science, photolithography, artwork for solder screening, material science, and robotics have all been essential. Ultimately we're working toward a fully automated system, but I doubt we'll be able to plug all the gaps."

The full implementation of new electronics packaging and interconnection technology in American industry may be just around the corner.

Together, these laboratories provide facilities for designing, testing, modelling, and fabricating any conceivable type of packaging technology. EPIP should turn out to be an enormously beneficial research program. It deals with technology that will revolutionize the electronics industry by making products that have more function features, are reduced in size, and are less costly. With the help of EPIP, the full implementation of new electronics packaging and interconnection technology in American industry may be just around the corner. □



graphic by Lisa Stein

Transatmospheric Vehicles

Alternative to the space shuttle?

by John Szymanski

In wake of the space shuttle disaster, the vulnerability of the program has been exposed. Investigating the crash, redesigning the solid rocket boosters, and restructuring some of the management in National Aeronautics and Space Administration (NASA) is going to set the program back a year to a year and a half. But there is an alternative to the shuttle which has yet to be developed: the transatmospheric vehicle (TAV).

The TAV is a spaceplane capable of taking off from an ordinary runway, boosting itself out of the atmosphere into a low space orbit without jettisoning away any of its parts, then landing back on an ordinary runway. Flying speeds of various TAVs will range from Mach 5 to Mach 25 (Mach N being N times the speed of sound). Initially the military will be using the craft for sending payloads into orbit, but further development will render it useful to air travelers. The estimated flying time between London and Sydney, Australia traveling at Mach 25 would be 67 minutes, but more realistic craft speeds are pegged between Mach 5 and Mach 10. These speeds would yield a flight time from L.A. to Tokyo of around two hours. However, the TAV will not be ready for commercial use until the military is able to procure a satisfactory working prototype, which is expected around the year 2000.

The TAV could travel from L.A. to Tokyo in about two hours.

In March of 1985, President Reagan signed an order mandating the development of the TAV. Currently the program is in Phase II, which is the testing of components of the craft. Phase II should be completed by 1988. If Phase II is a success, Phase III, consisting of the building and testing of a test plane, will be initiated and should last through 1993-1995.

(continued on 13)

Ultrafiltration of Milk

Progress in Wisconsin's cheese industry

by David Chew

Everyone in Wisconsin is familiar with the license plate logo that reads, "America's Dairyland." Wisconsin produces 30 percent of the nation's cheese; it's a very big business here.

Chemical engineering professor Charles Hill has worked on research in the dairy industry since 1967, and is now a member of the Cheese Research Institute. Currently, he is working on an ultrafiltration process which could revolutionize the cheese industry, both on the farm and in the factory.

For every pound of cheese made, nine pounds of whey are produced. Whey is waste water which contains solids, mainly in the form of lactose and protein. Because of its high biological oxygen demand, whey is difficult and expensive to dispose of; this represents a major cost to cheese manufacturers. Professor Hill, along with Clyde Amundson and former graduate student Anne Slack (both of the UW Department of Food Science) has proposed a method of ultrafiltering milk on the farm before it is transported to the cheese manufacturer. This method would eliminate much of the unwanted whey that is produced.

Ultrafiltration is a separation process utilizing a semi-permeable membrane which allows low molecular weight materials to pass through while larger molecules are trapped behind. In the ultrafiltration process, pressurized milk is forced over a polymer membrane laid out in various configurations such as a flat plate, a 1-inch diameter open tube, many small diameter (100 microns) tubes, or even a spiral-wound membrane which is rolled much like a jelly roll.

Unlike reverse osmosis, in which only water permeates the membrane, ultrafiltration also allows the low molecular weight solutes such as lactose and mineral nutrients to pass through, leaving behind a highly concentrated, protein-enriched liquid (24% solids, 9.8% protein, and 11.5% fat). The permeate is a clear liquid containing no fat and a negligible amount of protein.

Anne Slack actually used two different membranes in her graduate work. One had a molecular weight cutoff of 8000 - 10,000 grams per mole, and the other had a cutoff of 3000 - 5000.

Ultrafiltration of the whole milk on the farm as the cows are being milked has been proposed. There are many advantages to this method for both the farmer and the manufacturer.

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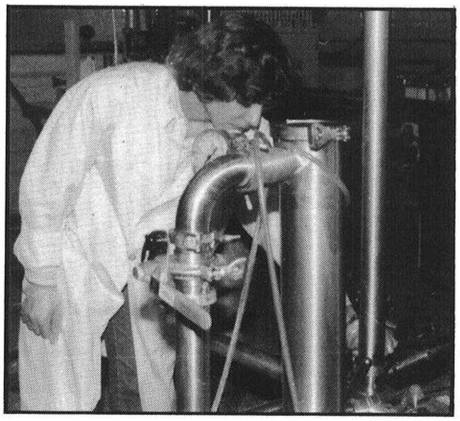


Photo by Pat Davidson

Graduate student Anne Slack checks the filtering apparatus.

The University Summer Forum

Subject: Strategic Defense Initiative

by Lisa Peschel

The College of Engineering, through the General Engineering department, is offering students and others a unique opportunity to learn more about one of the most significant social, political and scientific issues of our time: the Strategic Defense Initiative program.

Every year a different college at the University of Wisconsin-Madison sponsors the Summer Forum. It is held during the eight-week summer session as a series of Tuesday night lectures, and students may enroll for one credit. This year the responsibility for the Forum goes to the College of Engineering. The planning committee, chaired by General Engineering professor Gretchen Schoff and Electrical Engineering professor Leon Shohet, considered a number of themes such as robotics and computers, but they considered the SDI program to be the topic of broadest significance to both students and the public. They sought speakers who are familiar not only with the social and political importance of SDI, but also with the engineering and technology that will determine the feasibility of the whole program.

> **Speakers are familiar not only with the social and political importance of SDI, but also with the engineering and technology.**

By the end of the forum, attendees will be better informed on several aspects of the SDI:? -- What are the major components of the SDI system?

-- Which of these are feasible? Which are problematic?

-- What are the responsibilities of engineers and technologists in the SDI discussion and in the work carried out on it?

-- What are the social and political implications of SDI?

-- How is SDI viewed outside the United States?

Seven speakers, all renowned experts in their fields, have been selected to discuss these issues.

Dr. Robert Bowman is president of the Institute for Space and Security Studies in Maryland. His areas of specialization include high energy laser developments for space, development of advanced surveillance spacecraft, including radar and infrared satellite systems, and development of advanced space vehicle subsystems.

> **What are the responsibilities of engineers in the SDI discussion and in the work carried out on it?**

Professor George Bunn, former Dean of the UW Law School, is just finishing a teaching assignment at the Naval War College in Newport, Rhode Island. He is currently a member of the Lawyers' Alliance for Nuclear Arms Control, which will meet with the Association of Soviet Lawyers on the ABM Treaty.

Dr. Sidney Drell is the department director and executive head of Theoretical Physics and the Linear Accelerator Center at Stanford University. He is also co-director at the Stanford Center for International Security and Arms Control.

Dr. George Keyworth was Science Advisor to President Reagan and Director of the White House Office of Science and Technology from 1981 to December, 1985. He is co-founder of Keyworth/Meyer International, a company specializing in intelligence systems. The title of his lecture is "SDI as a Tool for Managing the Nuclear Era."

(continued on 16)

Aerodynamically Sound

Help for victims of vocal tract problems

by Mary Jo Lapadat

Although the University of Wisconsin does not have an undergraduate program in biomedical engineering, research projects in this field are abundant on the engineering campus. Engineers are applying their skills to everything from computer modelling of the musculoskeletal system to the creation of materials that can be used with human tissue to aerodynamic modelling of the vocal tract. The human body is the most complex engineering design there is. Applying engineering to better understand and solve the problems of the human body is not new, but not until recently have doctors and engineers truly realized the advantage of combining their efforts to solve medical problems.

Traditionally, medical problems have been solved by the method of trial and error, and unfortunately some of that is still going on today. Granted, this method has made possible many important medical breakthroughs, but there had to be a safer way to make advancements in medicine. The solution, and the trend of the future, is to have engineers and doctors work hand in hand to better understand this amazing machine, the human body.

That was the attitude of Assistant Professor Patrick V. Farrell of the Mechanical Engineering Department. When a group from the Waisman Center's Department of Communicative Disorders came to the ME department and told Farrell what was currently being done for victims of vocal tract deformities, Farrell thought there had to be a better approach. The current approach was trial and error surgery to reshape and rebuild the vocal tract, which often resulted in up to four or five unsuccessful operations per patient.

The current approach is trial and error surgery to reshape and rebuild the vocal tract, which often results in up to four or five unsuccessful surgeries per patient.

The Waisman Center group came to Farrell because of his knowledge in fluid mechanics. They wanted to understand the entire sound-producing process which meant, among other things, understanding the mechanics of air flow through the vocal tract.

There are two ways to look at the vocal tract and the production of sound from an engineering standpoint. The electrical engineer looks at the vocal tract as an amplifier which converts pulses of air into sound, whereas the mechanical engineer sees the vocal tract as a flexible pipe which passes a flow of air to the mouth. The electrical engineer tends to model the vocal tract as a circuit of resistors and amplifiers, whereas the mechanical engineer will model the same vocal tract using springs and dashpots. Current models exist in both forms and many have been partially successful in simulating human speech, but, due to the difficulty of simulating consonants, none have been completely successful.

Farrell, looking at the problem as a mechanical engineer, believes that the reason for the lack of success is not that the assumptions that have been made for the models so far are incorrect; rather,

graphic by Mary Jo Lapadat

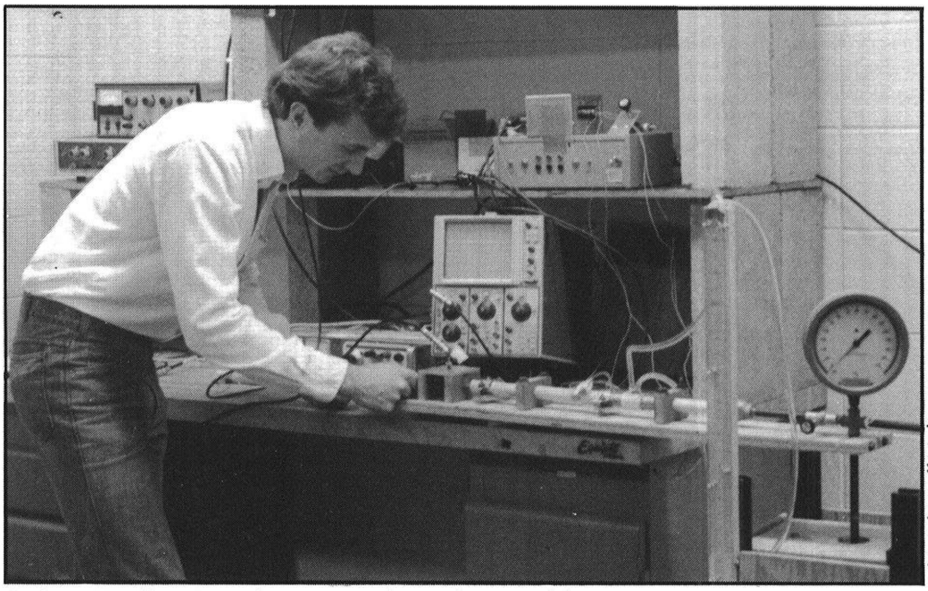


photo by Jeff Molter

Professor Farrel's assistant demonstrates the vocal tract model.

they are incomplete. At first, researchers tried to apply Bernoulli's equation (a statement of the relationship between internal fluid pressure and fluid velocity) to the air flow through the vocal tract. When asked why they would use an equations whose every assumption is violated, Farrell responded, "They didn't have any knowledge in fluid mechanics. They would pick up a fluid mechanics book and use the first equation they found." When this didn't work, they concluded that it failed because the air flow was unsteady (Bernoulli's equation requires steady flow). More models were then made, this time assuming unsteady flow, but still they were not successful in producing consonant sounds.

Farrell proposes that the reason these current models are not working is because the air flow through the vocal tract has both steady and unsteady components. Current models neglect the effect of steady flow. Farrell is not certain at this point what experiments will accomplish his proposal, although he says he has some good ideas.

The funding for this research is coming from the UW graduate school, but this money runs out in June. When asked whether he had gone to the National Institute of Health for funding (the NIH funds the Waisman Center), Farrell said, "We won't see any money from the NIH until we demonstrate some results and gain recognition."

With a "shoestring budget" such as this, the materials available for building a vocal tract model are limited. His simulated vocal tract at this point is nothing more than a piece of pipe. On one end an air tank and a model airplane engine are attached. The air tank provides the steady air flow and the model airplane engine, which is nothing more that a tiny compressor, provides the unsteady flow. Along the pipe he has connected two microphones and a manometer to measure the pressure gradients along the simulated vocal tract. The sound is displayed on an oscilliscope where it can be compared to recorded human speech.

What happens if Farrell is correct and steady flow does prove to be the missing piece of information in modeling the vocal tract? If this is the case, Farrell's work will, in a sense, have just begun and all sorts of issues will have to be addressed. For example:

-- Can the framework of the current model be used with only slight modifications, or would an entirely new model be required?

-- How much detailed fluid mechanics work is needed?

-- The proposed model will have to be explained to many people with very limited fluid mechanics backgrounds. Will they be willing to accept such a model?

What are the long range implications of a study such as this? Many speech defects are simply the result of vocal tract deformities. These deformities can be caused by either birth defects or accidents. If engineers and doctors, working together, could produce a working model of a vocal tract, then trial and error surgery would be unheard of. In many cases, correcting the shape of the vocal tract is all that is required to help millions of people speak better or even speak at all. □

Civil Engineering

Two staff members are currently conducting research on wood structures. Both of these projects are being supported by the U.S. Forest Products Laboratory. Professor Steve Cramer is doing research on safety and economy in the utilization of wood structures. Professor Cramer is developing finite element analysis methods for use in studying and predicting the strength behavior of lumber. Professor Mike Oliva is developing new techniques for the design and construction of timber bridges.

Research is being done by Professor Robert Ham on capturing the gas produced in landfills and putting it to good use. His research has resulted in techniques for assessing the decomposition status of landfills and their potential for future decomposition. His current work is focusing on the microbiology of landfill decomposition.

Metallurgical and Mineral Engineering

Professor Y. Austin Chang reports that two new faculty members have been added to the staff this year. Reid Cooper is a graduate of Cornell University and a former employee of Corning Co., and Eric Hellstrom is a graduate of Stanford and a former employee of Sandia Laboratories in New Mexico. Cooper, a highly regarded professor in the field of ceramics, is currently teaching a 400 level course on that subject and Hellstrom is involved with undergraduate lab courses in metals.

Professor Chang also indicated that research is underway in the study of structure ceramics and electronic ceramics, where an attempt is being made to produce high temperature ceramics that are less brittle and more functional.

Quotes Worth Quoting

"You know the kind of abuse I mean. It's the stereotype that labels us with such endearing terms as squid, goob, enginerd, snoid, and dweeve. . . ."
-- Mary McDowell
Illinois Technograph

Look for in the future the WISCONSIN ENGINEER *Car Washes.*

Engineering Briefs

The WISCONSIN ENGINEER would like to thank all our supporting advertisers from the past, present and future for contributing to this fine student publication. Please help support us by patronizing our advertisers.

WE would also like to say 'thanx' to our whole staff for pulling together to get this issue out in time for the convention.

Engineering Mechanics

The Engineering Mechanics department is proud to announce that one of its assistant professors has been selected as a recipient of the Presidential Young Investigators Award. Walter Drugan is one of three at the university and one of only one hundred in the entire country to be selected for the award. Drugan's research is in fracture mechanics, where he is studying analytical descriptions of how fractures form and propagate.

There will be three new courses offered in the department next semester, all pertaining to the new numerical methods sequence. These classes (EM 505, 575, and 605) will concentrate on new methods of numerical analysis of problems with computers.

Once on a dark and stormy night, a knight was riding through the snow and bitter cold on his faithful St. Bernard when he saw an inn ahead. He struggled up to the door, followed by his dog, and asked the inn-keeper for a room. The landlord said there were no rooms available, so the knight said he guessed he'd have to climb back on his St. Bernard and ride on to the next inn. The landlord said, "Did you ride all the way here on that dog?"

"Of course," said the knight.

"Then I'll find you a room. I wouldn't send a knight out on a dog like this."

NASA and the UW

Working together to put man on Mars

by Brian Grabowski

"Mars is the next step in the 'new frontier', man's second step away from the Earth...." This opening statement, from a class report for EM 569, echoes the entire motivation behind ongoing sponsored work at UW-Madison for the National Aeronautics and Space Administration (NASA).

The ultimate goal of EM 569 and NASA is to send a manned mission to Mars by providing designs and plans and solving the problems involved in such a mission. Mars, the next step in manned planetary exploration, may hold answers to questions of our own existence on Earth. At present, the surface of Mars is a barren, frozen wasteland, without evidence of planetary life. However, some evidence hints that at one time the planet did contain a more Earth-like surface with flowing rivers, lakes, and possibly life.

Why is a mission to Mars unique among NASA projects? With an 18-month travel distance from Earth, Mars provides a challenge to man unlike any other space project. For the first time in space, man would be unable to make an emergency

A mission to Mars would have to provide life support for at least three years just to accommodate travel time.

return to Earth, as in previous space missions. With these conditions in mind, a mission to Mars would have to provide life support for at least three years just to accommodate travel time. Colonization is the ultimate goal, but colonization would mean sustaining life support for even longer periods of time in the hostile, isolated climate of Mars.

Of all the planets in our solar system, Mars' climate and atmosphere is closest to the Earth's in composition, but it is still far from ideal. Dangerous radiation levels, extreme cold, and an unbreathable atmosphere are all present on the planet. To further complicate designs, its gravity is one third of the Earth's and periodical dust storms that will block the sun are anticipated. Certain factors, such as soil composition, are not even known yet.

UW-Madison's Engineering Mechanics program is well suited for designing Martian structures.

NASA is working with several universities across the country. Each university is researching a different aspect of future space exploration. Why choose the UW to work on the Mars Project? According to Ron Thomson, a primary developer and an advisor for the UW Mars Project, UW-Madison's Engineering Mechanics program is best suited for designing Martian structures. Other NASA projects consider problems with a strong emphasis on Flight and Aerospace Mechanics, subjects of a relatively weak background in UW's undergraduate Engineering Program.

EM 569, an undergraduate course under Thomson's direction, offers the opportunity for students to participate in meaningful research for the Mars Project. This is the second year the class has been offered. The class, which is divided into individual teams, is primarily student-organized and developed under Thomson's supervision. This allows for design areas suited directly to the students' interest. Last year's topics of study included Design of the Habitat Shell, Thermal Management, Space Allotment, Water Production, A Mars Greenhouse Design, Overall Power Requirements, Radiation Protection, and Disaster Management. This year, topics have become more specific and more detailed. They include Design of a Portable Oxygen Production Unit, A Greenhouse Lighting System, Soil Movement, and a Mars Versatile Rover/Construction Vehicle.

A Mars Project would occur only after the successful completion of a NASA space station and several unmanned trips to Mars. This means that manned trips to Mars most likely will not occur for another 25 years. More realistic estimates place the mission within a 50 year time frame. This aspect of the project means designing for technologies of both the future and the present. While this proposes design problems of a very complex nature, it also provides for some creative license and imaginative solutions to these problems.

What about the feasibility of this project in light of current government cutbacks of the NASA program and the recent shuttle disaster? Thomson speculated that it is realistic to assume some immediate delay in the NASA schedule due to the Challenger accident. In the long run, however, the timetable of a Mars mission should not be significantly altered.

Mars may hold answers to questions of our own existence on Earth.

While NASA hopes to benefit from the work of the UW, the joint effort between the two groups also directly benefits the University. Support for class expenses, speakers from NASA, and summer NASA internships are all results of the MARS Project program. Class speakers are usually representatives from NASA; these speakers provide students with the opportunity to talk to and learn directly from specialists in this organization. Those fortunate enough to work in summer internships are encouraged to return in the fall to get new students "up to speed" on Mars Project knowledge. This helps to keep the overall progress of the class moving forward rather than re-solving old problems encountered by a previous class.

At the present time EM 569 is a required course in the Engineering Mechanics curriculum, one of the smaller engineering programs on campus. It is the second in a series of courses involved with EM design. Unfortunately, only EM students can enroll for the course. However, classes are available in the EM department which deal with similar topics but are not limited to EM students. Next fall EM 699, a Special Topics course, will deal with a lunar-related project topic. Local industry, specifically the Astronautics Co. of Madison, has also expressed interest in developing some type of work on a NASA-related course. Hopefully, this will result in future "space engineering" classes in the engineering curriculum.

A trip to Mars is by no means "just around the corner" in NASA's future plans. Many problems of the mission will not be solved until unmanned missions to Mars are completed and some technological advances are achieved. However, Mars seems to be a definite goal in the years to come. It also seems definite that UW-Madison will be a part of that future and, hopefully, the work of today's EM 569 classes will be part of future missions.

(continued from 6)

Lana Couch, NASA's manager of the aerospace plane program, said that three critical technologies have come together: advances in air-breathing propulsion (the scramjet engine), the creation of light heat resistant materials, and recent advancements in computing power. Preliminary designs indicate that much of the aircraft must work interactively. For example, the cryogenic fuel liquid hydrogen will be pumped underneath the skin to be used as a coolant. The entire bottom of the plane will be shaped as an air intake funnel. Because of this interaction, one change affects many others in the design process. "The whole thing is a massive thermodynamic computation. You really couldn't do it without supercomputers," says one expert at the Defense Advanced Research Agency (DARPA).

Experts say that the propulsion system is the most important area of concern. NASA has been testing scramjets (supersonic ramjets) for the past three years and has only been able to obtain a speed of Mach 7. A ramjet is an engine which relies on its surroundings to provide the needed compression and heating for high pressure combustion, unlike an airliner engine which uses turbines to create the compression and heat. A scramjet does what a ramjet does, but faster. Aside from the workings of the scramjet, NASA and DARPA are faced with the problem that a scramjet does not work until it is traveling at Mach 4 (twice the speed of the Concord).

A major proponent of the TAV and former science adviser to the President, George Keyworth II, said that he is sure the plane would reduce the cost of carrying cargo by a factor of five, if not 100. This could be very important to the Strategic Defense Initiative program, because a tenfold reduction of current costs has to be made to be within current budget limits. Less costly trips to space could help cut expenses significantly. □

The Art of Procrastination

by Lisa Peschel

"Never put off until tomorrow what you can put off until the day after tomorrow."

-- Mark Twain


WE Photo Library

All the necessary equipment for an all-nighter.

Got something BIG due on Monday? Don't worry about it. Some of people's best work is done under the thrill of a deadline; almost every college student can tell stories about hellish all-nighters that resulted in pretty decent papers. But if you're one of those people who always has papers done a week ahead of time, who's always three classes ahead on the assignment syllabus, help is on the way: if you can force yourself to put your project off until the weekend, you too can join the illustrious ranks of that special breed called the procrastinators. Just follow these simple hour-by-hour instructions.

SATURDAY

11:00 a.m. - Wake up. As the sun shines in your window, roll over sleepily and smile. Ah, Saturday. . . . All of a sudden you remember. Oh rats. You've got a paper due on Monday. Dive back under the blankets and sleep for at least two more hours.

1:00 p.m. - Wake up again. Get out of bed and take a very long shower. Dress in comfortable study-type clothes.

Got something BIG due on Monday? Don't worry about it.

12:00 p.m. - You've heard that fish is brain food. Eat two cans of tuna for lunch. Go upstairs; sit down at your desk. You're still kind of tired and a little out of it; better go out and get some fresh air and exercise. Go play basketball with your roommates.

4:00 p.m. - Come back. Sit down at your desk again. Discover that it's hard to think when you're sweaty. Take another shower.

5:00 p.m. - Sit down at your desk again, awake, clean, dressed, and ready to work. Your roommates come in and tell you that onions are brain food and you'd better go out and get a gyro with them.

6:30 p.m. - Return home. Brush your teeth and use mouthwash. Hope that you don't burn holes in your paper with your breath. Decide to do a little other homework first, just to get yourself in that old studyin' mood.

7:30 p.m. - Phone rings. It's one of your old dorm floormates. Butch, your legendary next-room neighbor, is having a party for 80 or 90 of his closest friends. Reminisce fondly about the time the three of you took a hair dryer and a box of baby powder and turned your creepy housefellow's room into a talcum winter wonderland. Say you'll meet him there in half an hour. Swear to yourself that you'll come home early, go to bed, and get up at 8 a.m. to start working.

SUNDAY

1:00 p.m. - Wake up with a headache as big as Elroy's expense account. Oops. It was such a good party that you kind of forgot to go home early. Get up and take some Alka-Seltzer. Scrape the fuzz off your tongue.

2:00 p.m. - As long as you are having lunch, you don't have to start your paper. Eat for two hours.

4:00 p.m. - As long as you are in the shower, you don't have to start your paper. Shower until the hot water runs out.

4:45 p.m. - Boy, is your room a mess. Pick up all the junk on the floor. Wonder why you bought a carpet; you never get to see it anyway. Find a letter from your mom. Write back to her. Hope she doesn't die of surprise.

5:30 p.m. - Okay, this is it. Sit down at desk, pen in hand, no ideas in brain. Your stomach makes a lonely noise at you -- Hallelujah, saved by the growl. Eat supper. Slowly.

7:00 p.m. - Amazing Stories is on. It only lasts for half an hour. Think about how much cash the network payed Spielberg to do the show. You might as well help them get their money's worth.

7:30 p.m. - Time for Alfred Hitchcock. Maybe if you watch it, it will scare some ideas into your brain.

8:00 p.m. - Tear yourself away from the TV and sit down at your desk again. Think about the situation. You don't want to neglect your other classes just to get this paper done. Do all other homework for Monday. Think about beginning the paper. Do all other homework for the next week.

11:00 p.m. - Better watch Star Trek. Captain Kirk is an inspirational kind of guy; he might give you some ideas.

Midnight - Sit down at desk. Sharpen all pencils. Get new cup of coffee. Put new bulb in desk lamp. Get big pile of fresh paper. Work for ten minutes. Fall asleep face down in notebook.

1:00 a.m. - Wake up half hour later with spiral binder print on your nose. Give up and go to bed. Set alarm for 5 a.m. You'll finish it in the morning.

As long as you are having lunch, you don't have to start your paper. Eat for two hours.

MONDAY

5:00 a.m. - Alarm goes off. Bahahahaha. Joke, right? Turn it off and go back to sleep.

8:00 a.m. - Wake up; look at the clock. The adrenaline of panic begins to flow through your veins. Call in sick to work. Say you have leprosy or the plague or anything that sounds very painful and very contagious. Have a Twinkie and coffee for breakfast.

8:30 a.m. - Sit down at desk. Ideas flow through your head on a wave of sugar and caffeine. Start writing.

11:00 a.m. - Now comes the hard part: typing. Say a prayer to the great god White-Out.

1:00 p.m. - On your mark, get set, sprint to class.

1:19 p.m. - Arrive at class and hand in paper. Listen to lecture for ten minutes. Fall sound asleep, sitting straight up in your chair. Have a really wild dream about getting an A plus on your paper.

See? It's easy. Just think of all you'll get out of the experience: terrible coffee breath, terminally bloodshot eyes and fingernails bitten down to the knuckles. You'll also get a clean room, lots of exercise, maybe even a letter with a big check in it from your mom. Even if you don't enjoy yourself in the process, it'll still be worth it because you'll feel great when you're finally done. It's kind of like banging you head against the wall: it feels soooooo good when you stop. □

ATTENTION

Do you own a TI-55 II calculator? If so, you can get a brand new calculator absolutely free! Due to faulty circuit boards, Texas Instruments is recalling that model. If you call the company toll free at 1-800-842-2737 and tell them the serial number of your calculator, they will replace it with a TI-55 III. What a deal -- and you can't beat the price!

ATTENTION

When you graduate . . .
Take a little bit of Wisconsin with you!

Subcriptions to the Wisconsin Engineer magazine are inexpensive, and they're a great way to to keep up-to-date on new developments in the College of Engineering (not to mention Madison college life in general)! If you're graduating in May and would like to receive your first issue in July, just fill out the form below and put it in the Wisconsin Engineer mailbox (Mechanical Engineering Building Lobby, far right column of boxes) along with a check for the proper amount. You'll be glad you did!

-- I'd like to subscribe for ONE year. (5 issues)
I enclose $10.00.

-- I'd like to subscribe for THREE years. (15 issues)
I enclose $28.00.

WCAM

UW Students vs. Industry's Problems

by Nick Denissen

The Wisconsin Center for Applied Microelectronics (WCAM) is a research facility for electrical and computer engineers and applied math and science majors that many students have not heard of. This center was set up in 1968 by the Electrical and Computer Engineering department and it is housed at 1410 Johnson Drive. It gives students an opportunity to apply their knowledge of electronics in an industrial setting by working on projects together with company representatives.

WCAM gives students an opportunity to apply their knowledge of electronics in an industrial setting.

Ten companies from the private sector are involved in this program. The companies that sponsor WCAM are then able to use this facility for research applicable to them; they request WCAM to run diagnostic tests on faulty equipment, make improvements on existing equipment, and study the feasibility of new product ideas. This cooperation is beneficial to both parties. The students and the University benefit from the experience of working on real industrial problems, and industry benefits from WCAM's research without having to support its own facility.

A graduate student is currently designing a new chip for Ray-O-Vac at WCAM.

At the undergraduate level, students are working on the largest chip that the University has ever built.

The chip is a battery monitor, and the center has run into problems with its power source. The chip must be sensitive to small voltage changes. Therefore, unlike other chips, it cannot manipulate only the standard five volts. It must be able to use a power source of varying voltage. However, as soon as this problem is overcome, the chip will be finished.

This is not the only project being worked on at the center. At the undergraduate level, students are working on the largest chip that the University has ever built. It is a data manager for sensor input. The chip's architecture is ten times as complex as most chips.

Once these projects are completed, others will be chosen from 50 new project ideas. Undergraduate students work on projects related mostly to force sensors and pressure transducers which are used in instrumentation systems. They do get involved in designing and fabricating N-channel microprocessor components and CMOS gate arrays. Graduate students' projects involve chip design and mask fabrication.

If you are interested on working on these types of projects, contact the director of the Center, Professor Henry Guckel (Electrical and Computer Engineering). Mr. Dave Jones, a specialist who works with the center's microprocessors, may also be of assistance. □

(continued from 7)

Dr. Henry Kolm is founder of MIT's National Magnet Laboratory and several industrial firms. He specializes in electromagnetic launchers.

Dr. Roy Woodruff has served in several capacities within the University of California's Lawrence National Laboratory (LLNL) in Livermore, California, principally in the field of nuclear weapons research and development and in the X-ray laser program.

Dr. Gerald Yonas is Chief Scientist and the Acting Deputy Director of the Strategic Defense Initiative Organization. His specialties are the development and application of intense electron and ion beams, high power microwaves, lasers, high density plasma, radiation sources, and energy conversion devices.

Don Woolston, General Engineering Adjunct Assistant Professor, will lead the course. "I'm hoping to be pleasantly surprised by the large number of engineering students who enroll in the course," said Professor Woolston. "I should think that considering both social and technical aspects of a problem presents a challenge that many engineering students would like to accept."

Don't miss the chance to learn about this critical issue from the people who are most qualified to speak about it. To enroll, students should sign up for General Engineering 410-690-2. Lectures are open free to the public and they will be recorded by WHA for radio and/or TV. □

(continued from 6)

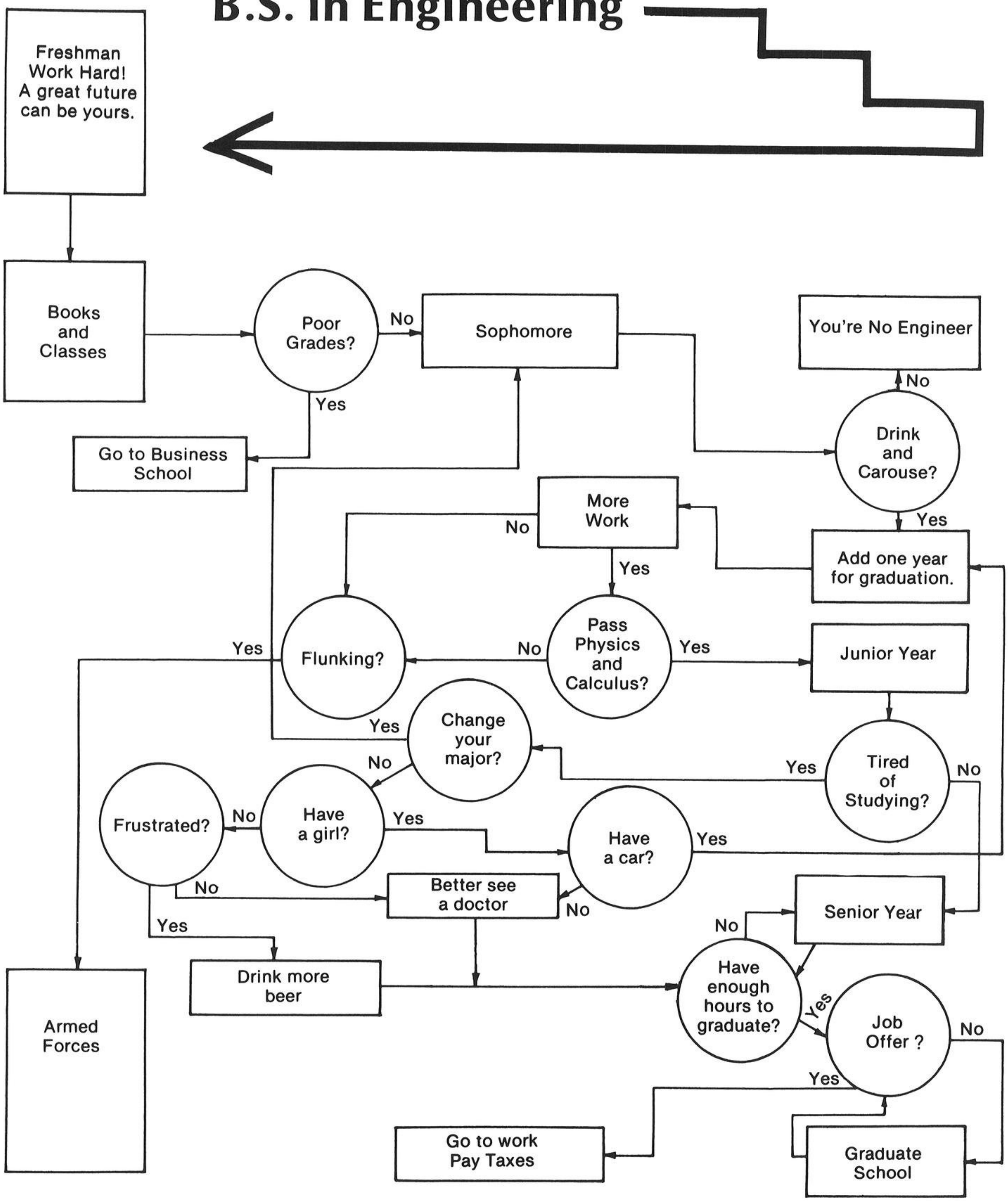
The benefits for the farmer result from a reduction in the fluid volume and weight. Much of the water is filtered out, so his refrigeration and transportation costs are substantially lowered. The manufacturer also benefits from the reduced volume which lowers the refrigeration, pasturization, and cooking energy costs, while at the same time increasing storage capacity and production rates. In addition, the amount of whey produced in the cheese production is greatly reduced.

The permeate produced by ultrafiltration contains water, lactose, and mineral nutrients. It can be used to feed the animals on the farm.

A follow-up economic study has been performed which shows that, for a farm with a herd of more than 100 cattle, definite economic advantages are realized by the farmer because of reduced refrigeration and hauling costs.

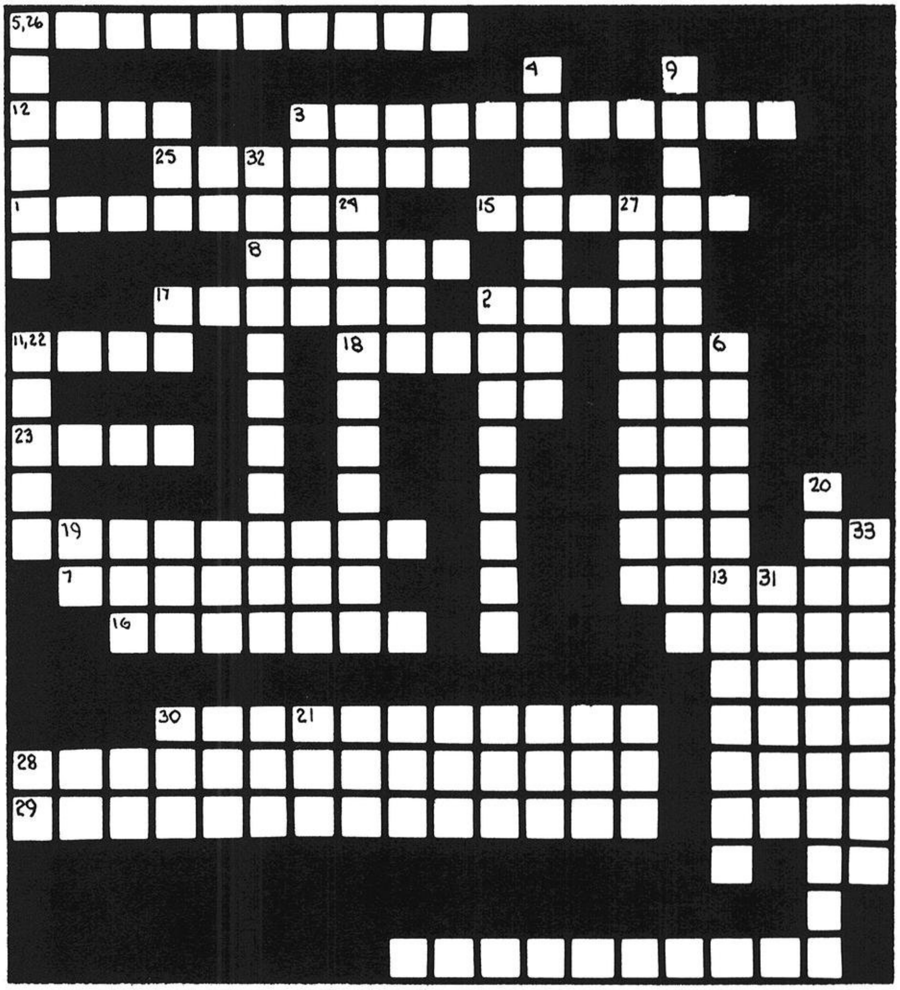
Professor Hill is quick to point out one of the problems with implementing ultrafiltration: politics. The concentrate which will be shipped to the market cannot be labeled as milk, so a new system of payment and pricing, based perhaps on fat and protein content per pound of concentrate, needs to be established. Currently, ultrafiltered skim milk is being used in cottage cheese production, so progress is being made. Stricter environmental regulations will also encourage many manufacturers to buy the ultrafiltered concentrate in order to increase the quality of the cheese plant effluent. □

B.S. in Engineering



—Reprint from USC Engineer

Crossword Puzzle



ACROSS

1. Dotted with a unit vector gives directional derivative.
3. Second word from #2 down.
5. Give and take.
7. Dimethylether and ethanol are?
8. He does the public physics demo each year.
10. If it's green it's bio.,if it stinks,chem.This one doesn't work.
11. Another name for a surface integral.First word only.
12. Co-editor of the WE who doesn't moonlight for the Badger Herald.
13. Organization for college engineering publications.
14. What the WE is hosting 4/10-12/86 .
15. Local S.F. con.
16. Co-editor of WE that would not be described as tall, dark and handsome.
17. Not superimposable upon its mirror image.
18. Responsible for space exploration.
19. Interface between a human and a computer.
23. Causes you to stay up later than you usually would to study.
25. Twist wave.
28. A pair of mirror image molecules (non-superimposable).
29. Class of species used for electron pushing.
30. Used to store charge.

DOWN

2. Used to max or min a function subjected to a constraint function,use first word only.
4. To max or min.
6. $CH_4 + Cl{:}Cl > CH_3Cl + HCl$
9. What Bassam Shakhashiri did on the evening of 3/13/86 in Madison.
20. Sound is this sort of wave.
21. E/R.
22. If you run a current through a coil or put a charge on the surface of a object, what do you get?
24. The type of wave you get when you shake a telephone cord.
26. Causes voltage differences.
27. Energy is always...
31. Measure of charge.
32. Device used to slow down the discharge of #30.
33. Makes every thing sound louder than it actually is, i.e. the shower or the bed sheets...You get the idea.

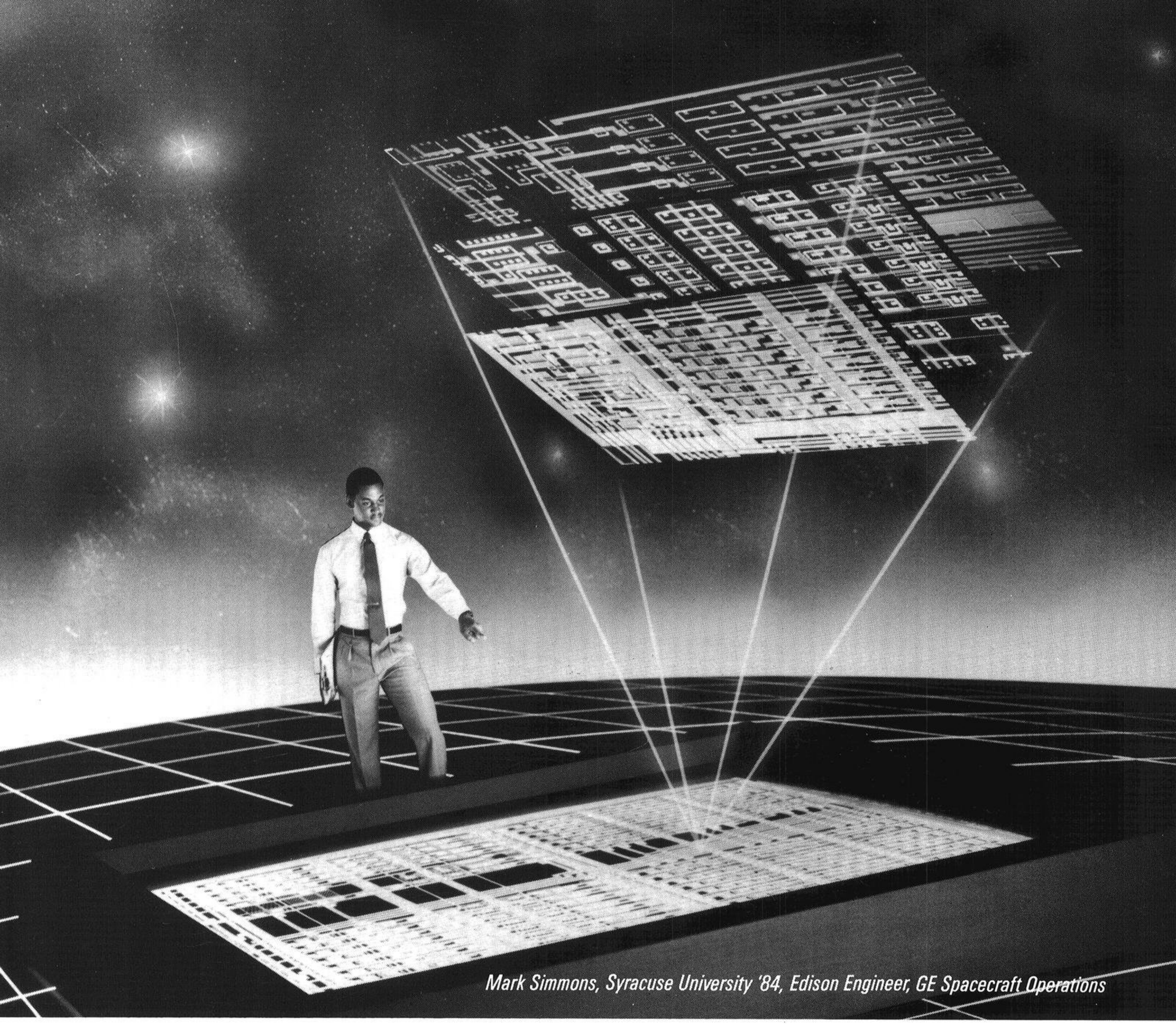
Just One More

WE Photo Library

The College of Engineering offered a new course this semester: ME000, Automotive Design for Business Majors. "How's it going?" you ask. Well, the first group project was made public last week.

by Gary Webster

WE Photo Library



Mark Simmons, Syracuse University '84, Edison Engineer, GE Spacecraft Operations

Design an Expanding Universe on the Ultimate Chip

At today's GE, young engineers like Mark Simmons are pushing micro-electronics to the limit, and beyond. In design applications that take them from the ocean floor to the automated factory to outer space.

With each breakthrough, an amazing revolution takes place. As each new GE chip design multiplies micro-processor capacity, so grows our capacity to design more powerful, more accommodating chips.

Consider some recent GE developments. Our custom-designed Graphics Array Processor converts massive amounts of information into simulated 3-D images. With far less time and expense than conventional computers require.

Or GE's Advanced Very Large Scale Integrated Circuits. With feature sizes a hundred times smaller than a human hair.

What's our "electronic blueprint" for the future? Solar energy chips that power their own intelligence and pave the way for deep space exploration. Fifth generation computers that build on the astonishing speed and capacity of chips taking shape today. Plus startling ideas still in the minds of our engineers.

If you're drawn to the challenges of microelectronic design, you should have designs on us. At GE locations throughout the USA, we design, manufacture, use and explore breakthrough applications in micro-electronics.

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