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OCTOBER 1986

wisconsin engineer

SPACE

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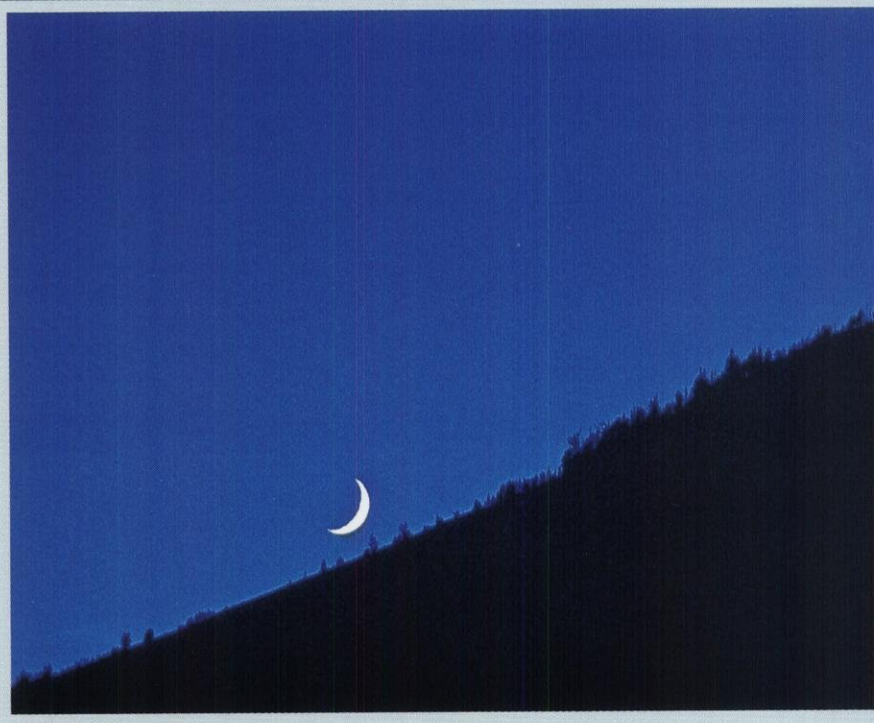

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IN EACH ISSUE

SPACE FEATURES

SPECIAL FEATURES

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The SDI: Should We or Shouldn't We?

Editorial

by Lisa Peschel

Like many students, I don't spend much time worrying about what's happening outside the Madison campus. I know I should be more aware. Unfortunately, with school, work and everything else, it's hard to make time to catch up on the news; besides, I have enough trouble figuring out what's going on in my classes, much less trying to understand current events and world politics.

But there's a first time for everything. This summer I received an offer I couldn't refuse: I was asked to run the slide projector for the College of Engineering's University Summer Forum. During the Forum, experts from all over the country came to Madison to discuss the Strategic Defense Initiative (SDI), Reagan's plan to make nuclear war obsolete by building an impenetrable defense against Soviet missiles.

While pressing the button on the projector, I absorbed quite a bit of information. The speakers all had different opinions on the ifs, whys and hows of the so-called "Star Wars"program, but they all agreed on one thing: they wanted the listeners to learn enough to ask intelligent questions and form their own opinions.

Much of the discussion was on the technical problems of the SDI. But the question that intrigued me the most was not, "Can we do it?"but "Should we do it?" I heard many valid political and ethical arguments from both the pro and con sides.

If we could develop an effective SDI system, its deployment might lead to peace and political stability between the U.S. and the U.S.S.R. Right now, our countries are mutually vulnerable. We have no way of stopping the Soviets' missiles if they choose to attack, but they know if they shoot at us, we'll shoot back at them. If one strikes first, both will be destroyed--this knowledge keeps us at a standoff.

However, if we had a perfect defense, there would be no reason for offense because there could be no advantage to a first strike. The Soviets could do no damage because we would deflect all their missiles. We could then abandon our own nuclear weapons because there would be no need to strike back; instead of basing our safety on the threat of retaliation, we could concentrate on defending ourselves, a much safer and more stable strategy.

There are lots of other factors that suggest we should go ahead full-tilt with research and deploy the SDI as soon as possible. For instance, consider that the Soviets are probably working on a similar program. Their government can pour as much money as it wants into weapons and defense without opposition from the people. If they know we are working on such a project, do you think they will let us get much of a head start? Also, think of the great strides technology could take with so much money and brainpower concentrated on the same topic. The applications could go far beyond war; for example, the same electromagnetic launcher that can fling a laser satellite into orbit could send a manned spacecraft out into the solar system.

However, as with any story, there are two sides to the SDI controversy. Maybe we could make a system that works perfectly and reliably, but there are reasons to hesitate before deploying it.

The most important reason is that the SDI might cause a war instead of preventing it. Of course, the system is only for defense. We don't plan to attack them--but, if they trust us as much as we trust them, why should they believe that? They might worry that we are planning to strike first, then use the SDI to destroy their weakened retaliatory forces. They might even fear the SDI as a first strike weapon itself. After all, if a laser can hit moving missiles in space, it could certainly hit stationary targets on the ground.

If the Soviets think their national security is threatened by the SDI, they probably won't sit there and watch us put it into operation. They might decide to strike our country first, to keep us from attacking theirs. Or they might disable the SDI itself. Or they might invent a new sort of weapon that the SDI can't stop, leaving us with several million dollars worth of high-tech junk. In fact, such weapons already exist; even the strongest SDI supporters admit that it cannot protect us from submarine-launched ballistic missiles or long-range cruise missiles.

So what is my conclusion after all of this debate?

I don't know yet. I'm still at the "intelligent questions"stage. But there is one thing I'm sure of. Nuclear weapons are the source of our worst nightmares, but they are also our greatest hope for lasting peace; for the first time in history, world leaders stand just as great a chance as the troops in the field of dying horrible, painful deaths. Perhaps now our presidents and premiers and prime ministers will stop fighting amongst themselves and unite against a common enemy: war, and the threat of nuclear annihilation.

The factory workers and the housewives and the farmers and the executives--and the students--also have their parts to play. Reagan has to know what the American people think of his plans to end war, and to voice an opinion, the people must be informed. **Everyone** should take the time to find out what's going on with the SDI, especially engineers and others who can understand the complex technology involved. Their comments are invaluable because they can base their opinions on politics, ethics **and** feasibility.

The point of this editorial: The SDI program is part of the arms race, a war game where the finish line is **really** the finish line. Don't wait until someone hands you a slide projector before you take the time to learn about issues which could mean life or death--yours. □

Dean's Corner

Star Wars: Controversy on Campus

by Dean George Maxwell

Everyone naturally tends to avoid difficult issues, or to tackle new problems only if they appear to have relatively simple answers. However, to grow as an individual, one must resist the temptation to always go with the "tried and true." Educational institutions face the same decision and too often choose to ignore controversial issues which have a profound effect on our lives.

Thus when topics for the Summer Forum were first considered, there was a natural temptation for the College of Engineering to select a non-controversial topic such as "Technology for the Future." When "Star Wars" was first proposed to the Summer Forum Committee as a possible topic, the natural reaction was to reject it on the basis that it was too controversial, too volatile. It covered too wide a spectrum of problems and it would die a natural death before the summer. But the committee decided to look at the pros and cons of "Star Wars"in more detail. Problems with the topic included the possibility of heated debates and demonstrations, security problems, and the possibility of presenting an "imbalanced" view of "Star Wars." On the pro side, the purely technological nature of the subject would appeal to engineers, and the tremendous and obvious impact of the subject not only on the defense of the nation, but on society, economics and politics worldwide, would make it interesting to a wide audience.

Despite the obvious problems, the committee decided that no one else was likely to make such a presentation and that, as a leader in technology and a center for rational debate, the College had a responsibility to present such an important subject and cover its wide implications. The committee therefore decided that the official title of the forum should be "The Strategic Defense Initiative: Feasibility and Responsibility."

As the program began to develop, some of our worst fears appeared to be coming true. In October, former Secretary of Defense Robert McNamara made a presentation entitled: "Reducing the Risk of Nuclear War: Is Star Wars the Answer?" I have seldom felt threatened by a crowd, but at this presentation I and others I talked to later experienced a very real sense of fear. We also had problems in obtaining definite commitments from speakers who were at the forefront of their particular fields. The committee decided to double its efforts and plan for all eventualities, including the possibility of serious controversy and last-minute cancellations.

I would like to comment on why I believe the Summer Forum was, overall, such a positive experience for students, the Madison community, and the College of Engineering.

About 80 students took a one-credit course based on the forum lectures; about half were engineering students, and the other half were from "across campus." They all benefitted from the interaction between the hardware-oriented engineering students, fascinated by the technology that would make for a more sophisticated defensive system, and the "across-campus" students who were concerned with directing more effort into diplomacy and peaceful solutions to world problems without leaning heavily towards technological solutions. The class ended up being evenly split on whether advances should be made in SDI, but everyone agreed that they benefitted from the diverse views of the speakers--all obviously well-meaning, patriotic Americans--but with different views on the solution to a very complex problem.

The Madison community benefitted as well. Newspaper articles and television coverage do not give citizens much of an opportunity to express their concerns about current issues to those who are in a position to influence decisions. Members of the community who came to campus for the lectures were treated not only to excellently delivered presentations on topics ranging from the technology of electromagnetic launchers to the possible political ramifications of non-compliance with existing treaties, but also to an opportunity to express themselves during lively question-and-answer periods with people who could have some influence on the direction of the SDI.

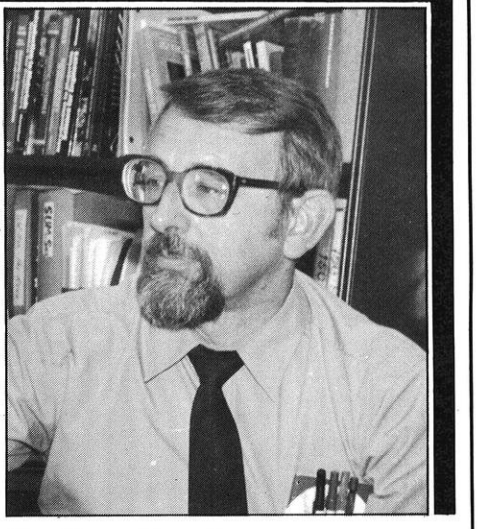


photo by Paul Driessen

Dean George Maxwell

Finally, the College of Engineering itself gained from hosting the University Summer Forum in that it probably shattered the stereotypical image of engineers as inarticulate individuals concerned only with technology. Professor John Mitchell, Chairman of the Department of Mechanical Engineering, and Professor Gerald Kulcinski of Nuclear Engineering stood out in particular as forum participants who gave polished presentations and thoughtful answers to difficult questions with their wide knowledge of the effects of technology.

The SDI Forum was a risky topic, but we all gained from the decision to discuss the tough, often uncomfortable issues surrounding SDI, including the inescapable need for research on defense and the role of universities in that research.

The College administration and the Summer Forum Committee should be congratulated for taking on such a controversial issue and following through in such an exemplary manner. Chief Hansen of Protection and Security wrote in a letter to Chancellor Shain, "The program was presented in a balanced manner that reflected careful planning and thoughtful consideration of the issues involved," and "The positive results attained by the Engineering staff clearly demonstrates that controversial lectures and speakers can be successfully programmed here on campus." □

The NASA Grant

Cool millions for hot research

by Steve Green and Jerry Hill

Ideas that once belonged to science fiction are now research projects of the College of Engineering, thanks to a million-dollar-a-year grant from the National Aeronautics and Space Administration (NASA). Space automation and robotics, lunar mining of He3, food-producing orbiting greenhouses, and space-based automated manufacturing processes will be researched by the Wisconsin Center for Space Automation and Robotics (WCSAR). The WCSAR is managed by the College of Engineering; various Wisconsin industries will work closely with the Center and support it. This August, the center became one of nine Centers for the Commercial Development of Space (CCDS) to receive funding from NASA. The CCDS will reduce the cost of launching the space program into the 21st century by encouraging the private sector to cooperate with engineering and science talent within the country's universities.

John G. Bollinger, Center Director and Dean of the College of Engineering, said NASA received twenty-five proposals for CCDS. "Ours was successful because it draws on long-standing expertise our faculty has in robotics, automation, computing, fusion technology and agriculture, and because it has outstanding support from industry and the state of Wisconsin," he said.

The Center has outstanding support indeed, especially from the WCSAR's industrial research partner, Astronautics Corporation of America (ACA). In 1984 Dr. Eric Rice, Manager of the ACA Technology Center in Madison, began discussing plans for a CCDS with Dean Bollinger and other interested UW faculty. By the time the University of Wisconsin College of Engineering was ready to submit its proposal to NASA in April of 1986, Rice and the ACA had pledged $200,000 a year in industrial research development funds to the Center's goals and had enlisted nine other Wisconsin and Illinois companies to contribute $210,000 in funding and equipment for the Center's first year. Two more have recently joined, bringing the total to $450,000.

In addition to industrial support, Governor Anthony Earl is seeking $250,000 a year for the Center from the Wisconsin Technology Development Fund. By concentrating mostly on Wisconsin industry for support, the WCSAR hopes to make Wisconsin a new national center for space technology and commercialization. Dean Bollinger said, "This is one of the largest grants our college has ever received. It is also important because it puts us on the forefront of space technology, and allows us to work closely with our state's industry."

ROBOTICS

The astronaut, although vital to any space operation, is also a very expensive, high-risk commodity. It takes an astronaut four hours just to prepare for extra-vehicular activity (EVA) and, once in space, his time and abilities are limited. If a man is to be replaced, his successor must have complex and agile arm-hand control, a versatile torso, strength, and the ability to withstand the airless, icy realms of outer space. The Maneuvering Anthropomorphic Robotics System (MARS) meets all these requirements.

The MARS would be a human-like robot that can perform various functions normally handled by an astronaut, such as satellite repair and maintenance. Astronauts inside the spacecraft (the Space Shuttle, for example) would have complete control over the robot and would receive visual and sensory feedback from it.

The "Astro-Buddy," as referred to by Mr. Ron Teeter, Manager of the Space Systems Department at ACA, would consist of a complete rotating torso with two stabilizing and two manipulative arms. The torso would have electrical power and data transfer interfaces through the Remote Manipulator System (RMS) of the Shuttle. Mounted within the torso would be two television cameras, providing the astronaut with a robot's-eye-view, 3-D picture.

The astronaut would control the MARS through a pair of mechanical sleeves that would translate the operator's movements so that they could be imitated by the robot. In turn, all textures and contours that come in touch with the MARS' hands would be felt by the operator's hands through a tactile sensory substitution system.

Tactile sensory devices, currently being developed by bio-medical researchers at the UW, provide sensory perception through gloves equipped with vibrotactile/pressure touch stimulation. With this invention, all the tasks of the astronaut could be performed by the MARS without the time, expense and risk of actually sending a man outside of the space vessel. Within the vessel, the astronaut has complete control over the MARS, including visual and sensory surveillance.

The MARS project will be directed by Dr. John J. Uicker and supported by Dr. Bahram Ravani; they will work closely with ACA. The short-term goal of the MARS project, or MARS 1, is getting the "Astro Buddy" to perform various maintenance tasks outside a craft such as the Space Shuttle. Eventually, the WCSAR would like to develop robots for more elaborate and commercial duties such as lunar mining and surveillance of orbiting greenhouses.

LUNAR MINING

The second project to be researched by the WCSAR looks fifty years into the future and concerns nuclear fusion as the ultimate source of energy in the 21st century.

The reaction

$$He^2 + He^3 \text{---}> \text{proton}(14.7\ MeV) + He^4(3.6\ MeV)$$

is a "clean" way of producing fusion power because the fuel and main reactants are charged particles, which are not radioactive.

As concern over the damage done to the Earth's environment grows, clean and economical sources of fuel must begin to replace present ones such as coal, natural gas, and petroleum. Nuclear fusion is one plausible and economical option, except that one component, He^3 (helium three), is incredibly scarce on Earth.

Natural gas deposits and the decay of tritium in nuclear warheads both contain the He^3 isotope, yet the amount of the two combined totals only 20-30 kg--not even enough to power a modest-sized electrical power plant for more than a few months. However, even though He^3 is rare on the earth, almost infinite amounts exist in space.

The primary sources of He^3 are the Sun, Jupiter, Saturn, Uranus, and

Neptune. Retrieving He^3 from the outer planets is not possible with today's technology. We cannot use the Sun as a resource either, but the solar wind emitted from the Sun carries He^3 at a speed of 450 km/s. Although the atmosphere and magnetic field of our home planet prevent the solar wind from reaching us, the moon, our nearest celestial neighbor, has absorbed infinite amounts of the isotope.

Samples brought back by the Apollo missions show researchers that the lunar soil has an isotopic ratio very close to that of the solar wind because the absence of both an atmosphere and magnetic field allow the solar wind to make contact with the moon's surface. The fine dust that covers the moon's surface has absorbed over 4 billion years worth of solar wind and is calculated to be up to two meters deep. Dr. Gerald L. Kulcinski of the Nuclear Engineering department estimates that the moon contains between five and seven million tons of He^3.

A part of the NASA grant will support research by the Automated Lunar Resource Processing System (ALRPS) to be directed by Dr. Kulcinski. Dr. Kulcinski and members of the ALRPS group will use the grant to study the most economical ways to extract the He^3, process it, and return it to Earth to be used as fuel.

Since the He^3 is contained within the lunar topsoil, it can be mined by simply carrying the moon dust from the mine site to the extraction plant.

The He^3 can be extracted from the lunar soil using virtually 100% natural fuel resources. During the lunar day, mirrors could heat the soil to 600 C, the temperature at which helium gasses would separate from the soil. During the lunar night, when the temperature drops to only five degrees above absolute zero, all the gasses except He^3 would condense. The uncondensed gas then need only be moved from the extraction site to a transporting vehicle to Earth.

Dr. Kulcinski calculates that 20 tons of He^3 (a Shuttle-sized payload) would be equivalent to the $50 billion worth of energy resources we used in the USA last year. He also foresees a ten-person lunar base operational by the year 2007 with the first useable He^3 being sent to Earth between 2010 and 2020.

GREENHOUSE

One very interesting topic for research is the development of a space greenhouse to provide food for astronauts working in Space Stations or stationary manufacturing plants on the moon or Mars. Dr. Ted W. Tibbetts of the Horticulture Department is in charge of research to determine if food can be grown in space less expensively than it can be shipped there from Earth.

The greenhouse feasibility study is only scheduled for the first year of the center's existence. If private companies become interested in the program, then funding from them would be used to start researching and designing the greenhouse.

Two stumbling blocks face the design and construction of the greenhouse: finding a way to direct sunlight to the plants, and developing a recycling system to be used where humans are present. The existing method of capturing sunlight through solar cells and then directing it to the plants is far too expensive to be used on the greenhouse, while a non-recycling system would require the expensive transport of plant food and waste.

Dr. Tibbetts envisions the greenhouse to be attached to a Space Station or moonbase where plants could feed off human waste (CO_2 and excrement for fertilizer) and in turn produce oxygen and food for the humans.

AUTOMATED MANUFACTURING

Although not defined in the UW's proposal, a new area of research is being planned that relates to automated maufacturing processes in space (AMPS). The concept involves the automating of various materials processing experiments that can eventually produce continuous new materials. Close coordination with all of the nine other CCDS's will be accomplished in this task.

COMMENTARY

As the 21st century approaches, the University, Astronautics, Wisconsin and Illinois industry, the state and NASA will all benefit from the research and development of space technologies. Competition among industries producing space technology will allow NASA to purchase materials for its programs at a lower cost than if NASA were producing those technologies itself. With companies fighting for new and expanding markets, space technology is likely to develop faster than it would if all space research fell on NASA's shoulders. Businesses will now have new markets to produce and sell in. Companies with interests in space (manufacturing, etc.) will need space technology in the future as will other countries; as a result, NASA will not be the sole purchaser of space-related products.

Financially, the University will also come out ahead. In addition to the obvious applications in the College of Engineering, the NASA grant will pay salaries for professors and TA's and provide money to the rest of the University; 43% of all grant money received by a college is paid to the University.

Academically, the university stands to gain top students and faculty interested in space research. Research opportunities will be available to undergrads as well as graduates working on their theses. Students and faculty outside the College of Engineering will also be needed to help in research; the Center will draw from the resources of the computer science department, the school of agriculture, other departments for academic support, and ACA.

Moving into space is an important part of this country's and the world's future. As over-crowding becomes a problem, the settlement of space will become necessary and WCSAR is a first step in that direction, helping to develop the technology needed for research and eventual settlement of space. UW-Madison, Astronautics Corporation of America, and other industry partners will be on the forefront of this important research, helping bring science fiction a little closer to reality. □

The Hybrid Synerjet

Into space with the best of both worlds

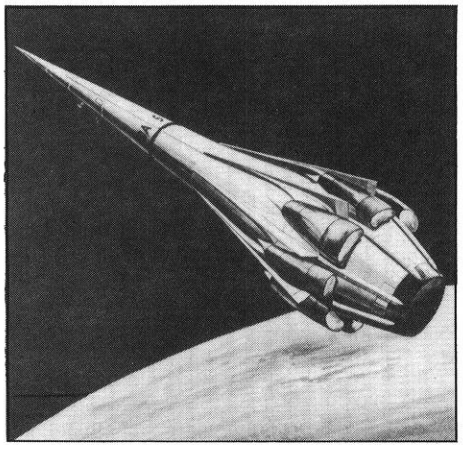
by Owen Gwynne

We've all wondered what space transportation will be like in the future. Movies show futuristic spaceships travelling into space as easily as today's commercial aircraft travel around the world. Most of us believe that's how space travel should work--ships take off and land without elaborate launch sites or hundreds of man-hours of preparation. This article will look at what some people believe is the key to that easy and affordable space travel--the synerjet. The synerjet is a new kind of engine that combines two very different existing systems: rockets and air-breathing engines. To understand why combining these two systems is essential to future engineers, we will take a close look at the advantages and limitations of both rocket and air-breathing engines.

The synerjet would combine several types of air-breathing engines and an advanced rocket system into a single engine.

Modern-day rockets have a number of features that make them an essential part of any future space travel. First, rockets are the only engines that function in space. Second, rockets are the only engines that efficiently provide enough thrust to lift a ship vertically off the ground. On the other hand, the major problem with rockets is that they need huge amounts of fuel, all of which must be carried by the ship. This rocket fuel consists of two parts: liquid hydrogen (the actual fuel) and liquid oxygen (oxidizer to enable the fuel to burn). The space shuttle, for example, must carry six times as much oxidizer as it does actual fuel. Pure rocket engines also need elaborate launch pads to deflect the exhaust blasts created during launches.

In contrast, air-breathing engines fill a number of the gaps left by rockets. First, since they don't need to carry any oxidizer, air-breathing engines are much more efficient than rockets while in the atmosphere. Second, air-breathing engines provide maneuverability in the atmosphere that rockets cannot. The two greatest drawbacks to air-breathing engines are their uselessness in the vacuum of space and their huge weight.



An artist's picture of the synerjet

To get the best of both worlds, a combination was proposed as early as 1966. The synerjet (which gets its name from the synergy or combined energy of both rockets and air-breathing engines) would combine several types of air-breathing engines and an advanced rocket system into a single engine.

This combined engine has several modes that parallel the three phases of a typical space mission. In the launch phase, both the rocket and air-breathing capabilities are used: first for liftoff thrust, and second for an efficient entry into space. While in space, the engine would operate as a pure rocket. While returning or landing, only the air-breathing capabilities would be used.

Now let's take a detailed look at how the synerjet engine would perform during a mission. The synerjet goes through as many as nine phases during a mission. The action of these phases can be roughly compared to shifting gears in a sports car. The first phase is launch, during which the rockets and air-breathing engines work together to lift the ship. The second phase of operation is from roughly Mach 2 to 6 (Mach N being N times the speed of sound). During this phase, the ship would operate using just the air-breathing engine. During the third phase, from Mach 8 to as high as Mach 25 (the speed needed to enter orbit), the ship would be powered by a highly advanced air-breathing engine. The fourth phase occurs in space. Only the rockets are used during the fourth phase. This completes the first leg of the trip that puts the ship into space.

The next five phases make up the return leg of the trip. This leg begins with phase five, a retro-firing of the rocket engine to slow the ship. The sixth phase is entry to the atmosphere using no power. The seventh phase is cruise, during which the ship uses its air-breathing engines to maneuver to the landing point. The eight phase is a loiter using a low power/low fuel air-breathing engine to position the ship over the landing point. The final phase is the actual landing using air-breathing engines to softly set the ship down.

The space shuttle must carry six times as much oxidizer as it does actual fuel.

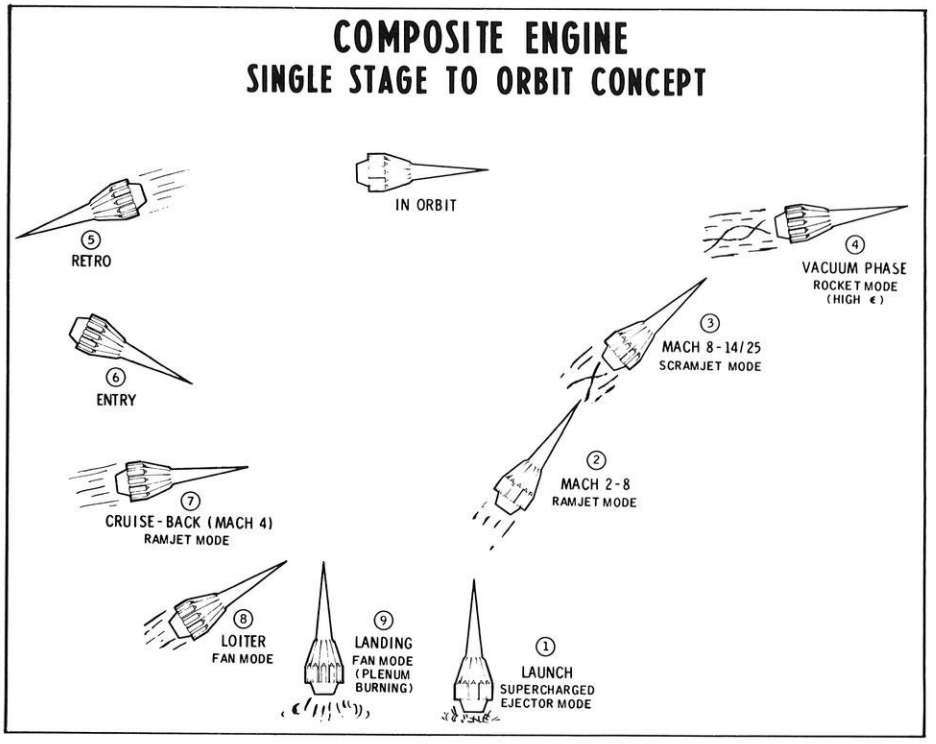
Now that we've discussed the various phases of operation of the synerjet, let's look at its three major advantages. First, the synerjet makes a single-stage vehicle possible, which implies a number of things. No hardware, like the huge fuel tank of the space shuttle, is burned up in the atmosphere. Only refueling would be needed to launch the ship again. Finally, the landing point would work well as a launch site, which would eliminate the need for cross-country travel on the back of another ship.

The second major advantage of the synerjet is the decreased ratio of fuel weight to total ship weight, since air-breathing engines don't have to carry liquid oxygen. This means that a synerjet-powered ship could put more payload in space than the same size rocket-propelled ship.

The final advantage to using a synerjet is its maneuverability after returning from space. After entering the atmosphere, it would act like a commercial aircraft. It

would be able to enter holding patterns around busy landing points and make sharp turns in flight. These are two abilities that the space shuttle doesn't have. The space shuttle is a glider while returning from space and must land on the first pass. The space shuttle must also enter the atmosphere through what are called re-entry windows. If the space shuttle were to miss its window it couldn't make the proper approach to the landing field, or it would miss the field altogether and it could not turn and try again. Using the synerjet would eliminate the restrictions of re-entry windows.

A synerjet-powered ship could put more payload in space than the same size rocket-propelled ship.



So if the synerjet is the ticket to space, what's standing in the way of building one? The major hurdle to producing a true synerjet engine is technology. At this point, no air-breathing engine operates from Mach 8 through Mach 25, as needed in phase three. However, this type of engine has been theoretically developed and is called a scramjet. One big problem with building such an engine is the lack of a testing capability. A test facility or test plane that can operate above Mach 8 doesn't exist. Therefore, the engine must be developed along with a method to test it. There is also a host of challenging technical problems involved in bringing rockets and air-breathing engines physically together. Still, quite a bit of progress has been made.

As early as 1968, comprehensive initial studies of a synerjet-type engine had been completed. There have also been a studies done over the years by different groups concentrating on various aspects of the synerjet. At this point, engines have been built and test-run that fulfill the requirements for the first two phases of the synerjet (launch and Mach 2 through 6.). As far as rocket technology goes, the space shuttle and Apollo missions have provided us with a highly developed rocket system. The technical details involved in the final phases of the synerjet model (loiter and land) have also been developed. But to be completed, problems with the middle phases of operation of the synerjet must be solved.

There are a number of companies with projects involving or relating to the synerjet. As an example of the people working right now, Lockheed-California recently placed an ad for engineers titled "Bring Your Career Up to Speed: Mach 25." In this ad Lockheed talked about work being done in hypersonics using scramjet and hybrid (synerjet) engines. In April, DARPA (Defense Advanced Research Agency) issued contracts totalling $500 million to develop an aerospace plane and its engine. The money went to GE, Pratt & Whitney, Boeing, General Dynamics, Lockheed, McDonnell Douglas, and Rockwell International, all of which will be on the cutting edge of future space technology.

Closer to home, an engineer in Madison is presently continuing his work towards a completed synerjet. His name is William J. D. Escher. Since the sixties, Mr. Escher has been involved in developing the theory behind the synerjet. He feels that the synerjet will be a "flying engine" by the year 2000 and that work on the synerjet will greatly expand in the next few years. So if you want to "bring your career up to speed," look into the future of the synerjet. □

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Reminiscing and Remodelling

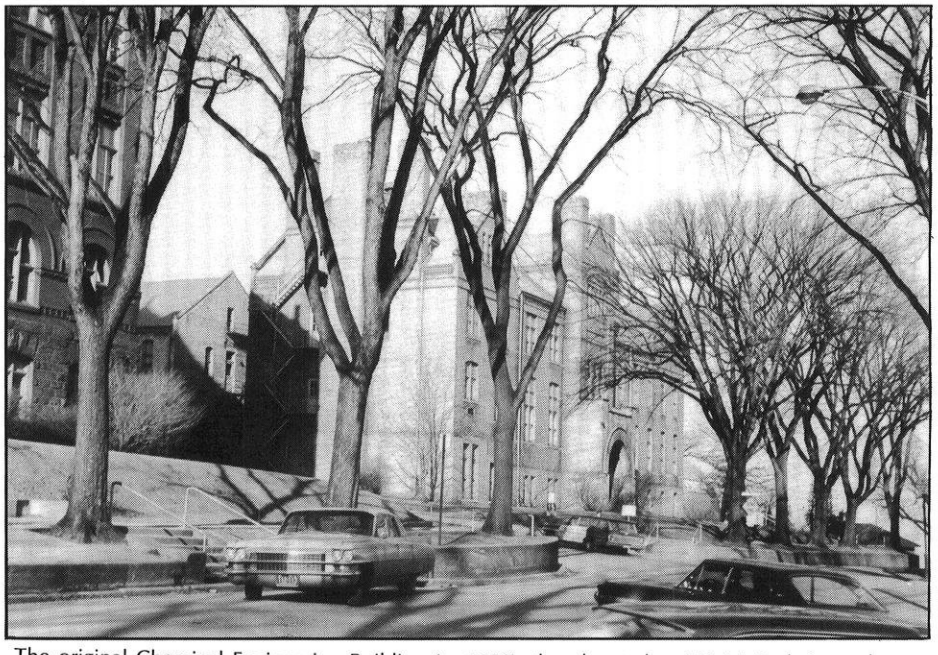
The College of Engineering's own space--on the ground

by Beth Bertling

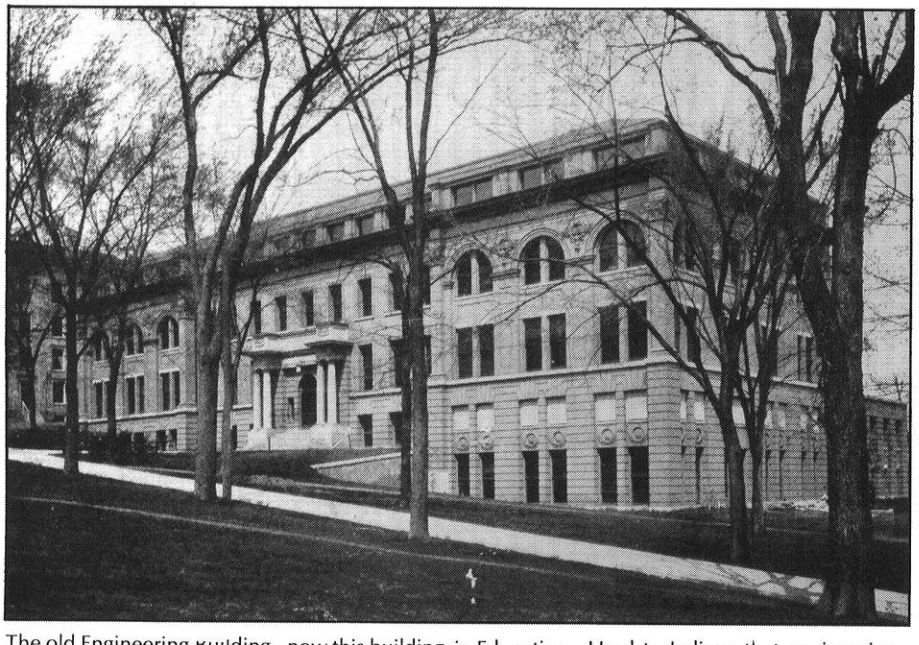
Space. The College of Engineering is seeking it out anywhere it can--even on the ground. If any of you plan to be around in the late 80's and early 90's, you will witness some major changes on the Engineering campus.

The University has approved plans to remodel and add to the Old Highway Lab Building or, as it is officially known, 1410 Johnson Drive. It will have 14,000 square feet of new space, and will most likely house the CAE (Computer Aided Engineering) facilities, a rheology research center, a biomedical engineering department, optics and machine design areas, and the Electrical and Computer Engineering Department's WISCOM--the Wisconsin Information Science and Communication Consortium.

Another plan submitted to the University is the proposal to build an addition into the courtyard of the Engineering Building. This new addition will provide more space for the Chemical and Electrical and Computer Engineering departments, and an auditorium that will seat about 1000 people. The administration hopes that this auditorium will be funded by private or corporate gifts and grants, and will be used to host speakers and other high attendance events. This plan is expected to be funded in the next biennial budget (1987-89). After funding is approved, it will be at least another two years before the building will actually be occupied, in 1991 at the earliest. Right now, this project is fourth on the list of priority building projects within the University; one through three on the list are the completion of the Memorial Library, the construction of a new building for the business school, and a building project on the agricultural campus.



The original Chemical Engineering Building (c. 1900), then located at 600 N. Park St. - where the Helen C. White Library is today.



The old Engineering Building - now this building is Education. Hard to believe that engineering students ever wandered about on Bascom, isn't it?

The project next in line within the College of Engineering is the building of another tower for engineering research--ERB II. This proposal has been submitted to the University, but funding isn't expected until 1991 at the earliest. This building would be built where the parking lot adjacent to the current ERB is now. If funding is approved according to the current schedule, the new ERB II could be occupied by 1993.

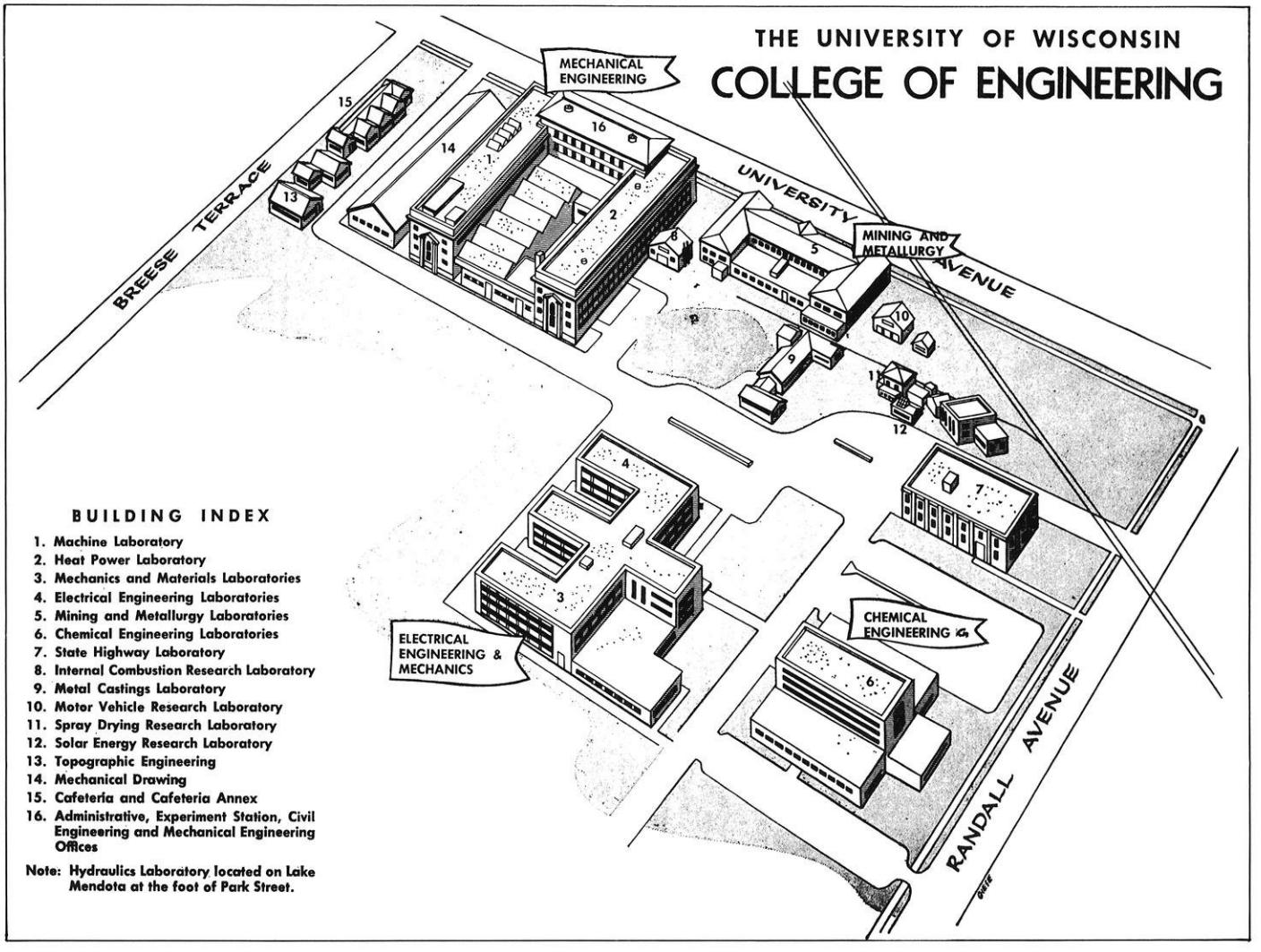
Other proposed but not yet funded building projects include: engineering research centers located on the corner of University Avenue and Breese Terrace (where General Engineering and the T-buildings are now located), an addition to the Wendt Engineering Library (where more audio-visual and computer application facilities would be located),

The foundation of the Engineering Research Building, 1967.

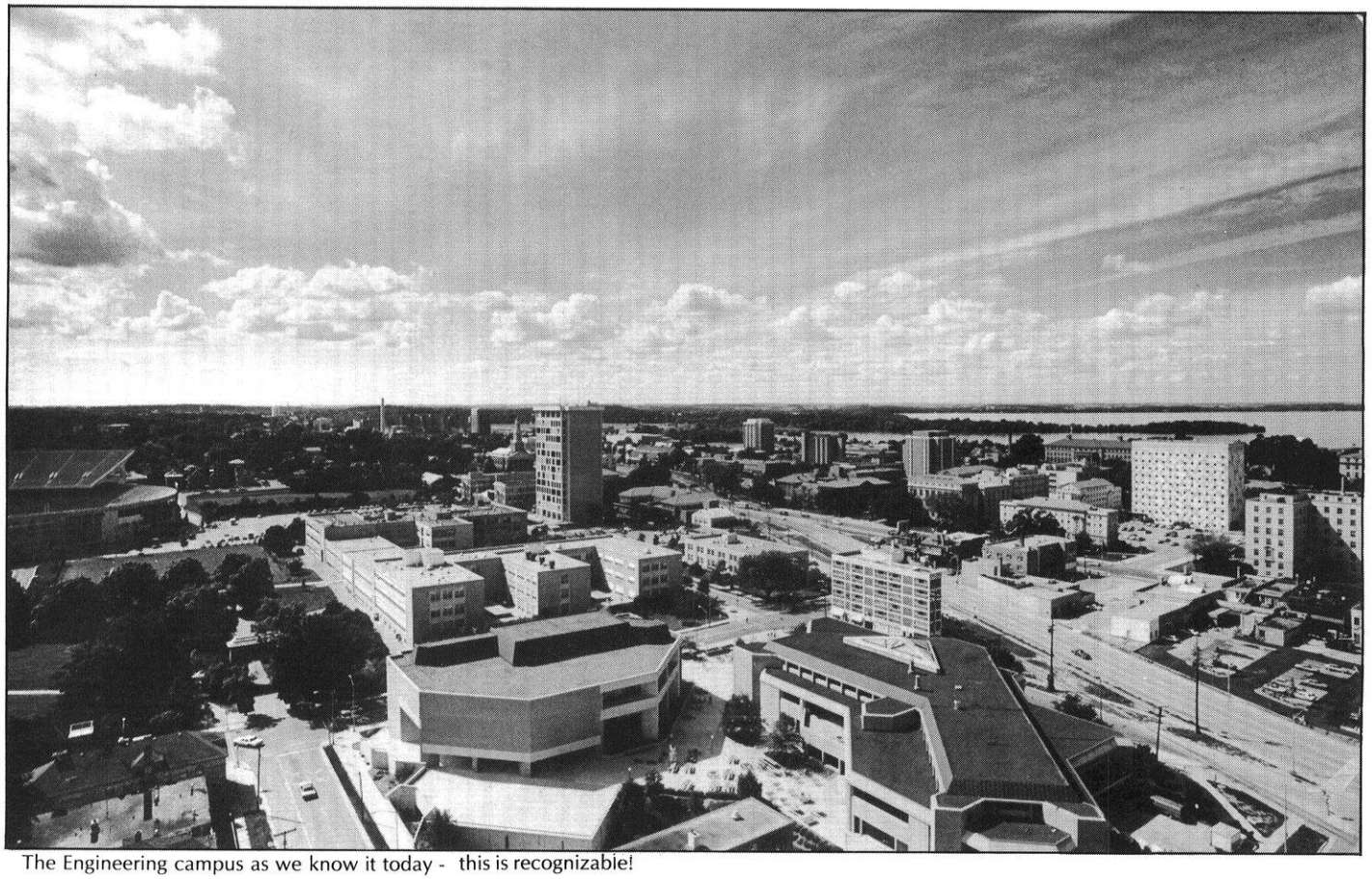
and, last on the list, a new addition to the Mechanical Engineering Building.

Walkways to connect the entire engineering campus have also been proposed. The walkways would connect the research centers to the Mechanical Engineering Building, the ERB II to the ECE portion of the Engineering Building, the ERB II to the new addition at 1410 Johnson Drive, 1410 Johnson Drive to the Chemical Engineering portion of the Engineering Building and, finally, the Chemical and Civil Engineering portion of the Engineering Building to the Wendt Library.

Most of these proposals, with the exception of 1410 Johnson Drive (which has already been funded), the new Engineering Building, and ERB II, are still in the dream stages of development. University budget constraints will determine the fate of all of these proposals, so all, few or none of the other proposals may actually materialize into buildings.



The Engineering campus as it appeared in this 1962 Engineering Bulletin.



The Engineering campus as we know it today - this is recognizable!

Visualizing the future seems to be as hard as visualizing the past. It's hard to believe that at one time, the Engineering campus consisted of the Mechanical Engineering Building, the Mining and Metallurgical Engineering Building, and a baseball diamond. The Chemical Engineering Building was located at 600 North Park Street--where the Helen C. White Library stands today.

The additions to the Engineering campus came slowly but surely as the College of Engineering realized that it needed more space. In 1946, plans were approved for the construction of a new Engineering Building; this building was to house mostly the departments of Chemical and Electrical Engineering. Construction began in 1948 and was finished by 1950. Eventually, additions were made to this building. The Engineering Research Building (ERB) was proposed in 1963 and completed in 1968. The Wendt Engineering Library came shortly after that. The following photos show the growth of the College of Engineering over the past fifty years or so.

It's interesting to see how much the College of Engineering has grown in the past half a century. Those of us who are really interested may stick around and get to see it grow and expand even more--way into the next century. □

From High Heels to Hard Hats

Co-oping with Impell Corporation

by Paula Grgurich

Impell Corporation, an international engineering consultant, has armed me with a new confidence in my own engineering ability, rewarded me with a lead field position, introduced me to a fun, new circle of friends, thrown me cross-country to witness/aid a new plant coming on line, and trusted me with the company credit card. Being off-campus for the past nine months, co-oping has offered me more experience and fun than I ever could have hoped for.

In Impell's Chicago office, my first major project was the BCSD/79-14 Verification Effort. I issued new pipe supports and support modifications to our client Commonwealth Edison at their Quad Cities Nuclear Station Units 1 and 2. The project introduced me to major industry codes and standards, Impell's unique CAEMIS software, and company politics.

At the same time, engineers at the Dresden 3 plant of Commonwealth Edison found evidence of stress corrosion in critical stainless steel piping. The piping, an essential part of the plant's power system, was located in a highly congested area. Our job of redesigning the affected six systems required complete analysis, design, procurement, installation, and inspection on a tight schedule to reduce plant downtime. I worked with many technically strong, experienced engineers, and I learned more in two months than I had in my entire college career. The practical experience has made engineering very real.

In April, I traded in my suit and pumps for a hard hat and levis to travel to another plant. A fast decision (I was given 48 hours), it has proved to be one of my best. At Texas Generating Utilities Company's Comanche Peak, I watched a small concern grow into a multi-million dollar project. The shaping of the Train C Program's methodology and the growth of the project at times still amazes me. Seismically addressing the Train C electrical conduit based on NRC-acceptable methods, we developed multi-level screening criteria.

Scaling the struts, hanging 50' up by a safety belt, crawling through cable, and walking life lines, I became an effective field lead. There were times when I was placed over men twice my age who had their master's degrees. The guys were great. We had many good times (Lake TaHoe 4th of July, Fort Worth Stockyards, Corpus Cristi road trip, raw oysters and St. Pauli's, jet skiing, sailing Lake Granbury, the monthly company-paid weekends). For a college student like myself, the consulting life was full of fun and excitement.

I cannot recommend co-oping enough. The benefits go beyond just receiving experience in electrical layout, vessels, retrofit, CAEMIS software applications, and seismic analysis. A blend of academic and real-world experience completes the picture. □

Engineering Briefs

by Mike Flader

and Brett Bridgham

WASHINGTON INTERNSHIPS FOR STUDENTS OF ENGINEERING

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WISE
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APPLICATION DEADLINE:
December 15, 1986

$$$$$$$$$$$$$$$$$$$$$$$$$

Honeywell is launching its fifth annual Futurist Awards Competition. The contest asks students to write essays about technological advancements they foresee by the year 2011. Essays can be about electronic communications, energy, aerospace, computer science, manufacturing automation or office automation and a second essay must address the societal impact of the technological predictions. Ten winners will be awarded $3,000 each and the opportunity to work at Honeywell next summer. Any full-time undergraduate or graduate student may enter; completed essays must be postmarked no later than January 31, 1987. To receive an official contest entry form and rules, write Honeywell Futurist Awards Competition, Honeywell Telemarketing Center, Honeywell Plaza - MN12-4164, Minneapolis, MN 55408, or call toll free 1-800-328-5111, ext. 1581.

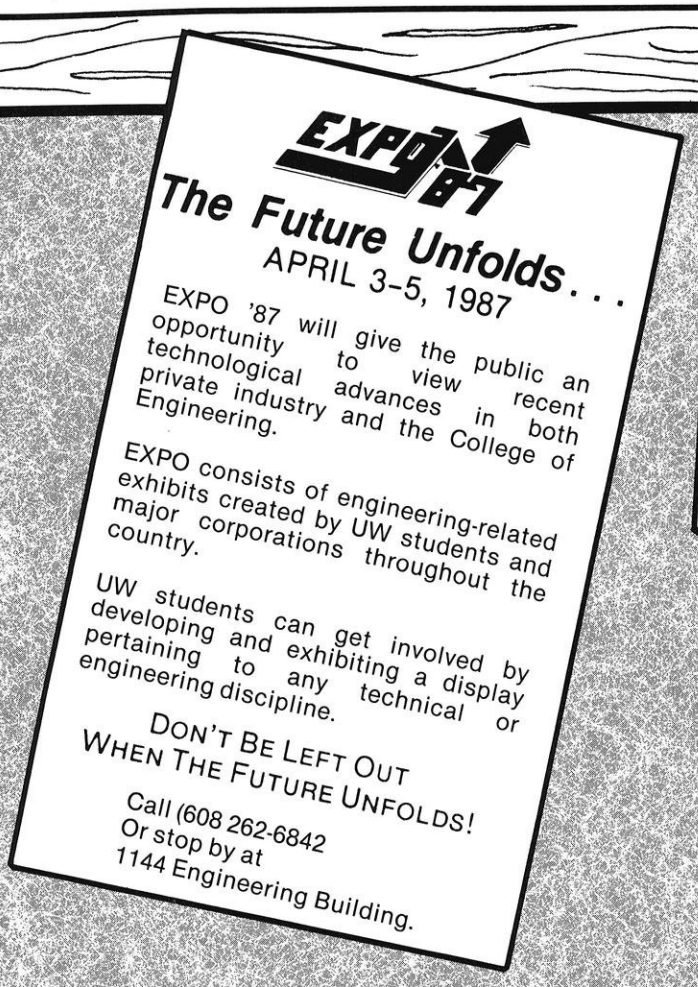
Nuclear Engineering

The Nuclear Engineering Department is currently expecting two visiting professors. A Russian engineer is scheduled to give a speech and Professor Gunther Kessler from the Republic of Germany will lecture on his experiences. Kessler is the director of the physics lab and head of the institute at the University of Karlsruhe, West Germany. He also teaches at the university and has done much research on the subject of fusion. He is scheduled to give six lectures on the nuclear fuel cycle starting in October.

Agricultural Engineering

The Agricultural Engineering department has a variety of ongoing research. One of the many interesting topics is the treatment of small-scale liquid waste. The objective of this project is to improve existing soil absorption systems which are environmentally safe. The approach being taken in this research is to develop a functioning at-grade system. Another element of this research is to use interceptor drains that lower the groundwater tables for on-site systems.

Another topic of research is the analysis of stray currents within barn enclosures. The stray currents set up by the various electrical devices within the barn cause an imbalance. This imbalance?of electrical impulses lowers milk production from cows. The alleviation of these stray currents could boost milk production throughout the dairy community. These projects and others in progress show the determination of the agricultural industry to produce products more efficiently.



Civil Engineering

The Civil and Environmental Engineering Department recently designed a flood control system for Stricker Pond in nearby Middleton. Stuart Wallace, a UW-Madison graduate student, designed the $80,000 system. He worked under the supervision of Professor Kenneth Potter. Professor Potter explained that roofs, asphalt streets, and other virtually waterproof surfaces now cover nearly a third of every developed acre in the area, and they prevent water from soaking into the ground. This has led to a change in the area's run-off patterns, causing the rainfall to reach the pond more quickly.

Although there is no history of flooding, the system was installed to prevent potential overflowing that might occur because of recent housing construction in the area. The system consists of a stand pipe placed in the pond's center. When the water level rises, water will spill down the pipe and flow through connecting pipes until it reaches an underground filtration chamber of sand and gravel, where it will seep into the ground.

Potter explained that this is a very unique application which has never been tried before. Furthermore, this system is almost completely hidden. The surrounding shore will retain its natural appearance.

Metallurgical Engineering

The Metallurgical Engineering department welcomes a new addition to its staff this semester. Fred Bradley is a visiting assistant professor from the University of British Columbia, Vancouver, British Columbia. His area of instruction is metal castings. He currently has proposals pending that would enhance the efficiency of the foundry operation. One such project is thermal analysis. The overall scope of this project is to develop a data acquisition system and corresponding computer software to achieve an integrated system. This would allow foundries to relate thermal analysis observations with parameters such as composition of metal, melting practices of the foundry, and various other procedures involved in the foundry operation.

In a separate but related project, Bradley is proposing to develop a finite element technique for modeling the solidification process. This complete modeling would take into account all possible heat loss and heat transfer processes involved in solidification during the thermal analysis test. Information such as this would be most beneficial in making theoretical predictions of metal solidification.

Project Trochos remains an ongoing area of instructional software development in the Metallurgical Department. Advancements in diffraction and lattice geometry software are accompanied by an increase in the data acquisition capabilities of that software. Beyond the scope of its initial intent, the project has been advanced in other areas of metallurgy such as fluid flow, mass transfer, and heat transfer.

Superconductive Magnets

Storing energy through the night--and for flight

by Pete Steinhoff

Superconductive magnetic energy storage (SMES) is an old idea that is gaining ground in a new field. Dr. Roger Boom is the director of the Applied Superconductivity Center at UW-Madison, which has done power supply research since 1961. The object of the work has been the development of SMES for electric utility use. With SMES, energy could be stored in a superconductive storage magnet at night (during low consumption levels) for discharge during the day (when consumption levels are at their peak). More recently, Dr. Henry Kolm (co-founder of the Francis Bitter National Magnet Laboratory at MIT) suggested using SMES as the power source for electromagnetic launching systems (ELS). He spoke about ELS during the Strategic Defense Initiative (SDI) Summer Forum sponsored by the College of Engineering. ELS are presently being developed to launch payloads into space.

SMES can provide the power to launch space vehicles so they will not have to carry huge amounts of fuel.

HOW SMES WORKS

Before commercial use and ELS use of SMES is discussed, it is important to understand how SMES works. An insulated wire (consisting of the alloy niobium-titanium encased in copper) is wrapped around a core spool to form a solenoid. Electricity is sent through the wire which induces a magnetic field. The SMES device is buried in bedrock and cooled to liquid helium temperature: 1.8 degrees Kelvin. The SMES device is typically a few hundred meters in radius.

COMMERCIAL USE OF SMES

SMES has been developed for commercial use. SMES could assist the Wisconsin Electric Power Company in 1995 by discharging power during peak load times, which occur during standard business hours. Late at night, when the base load is minimal, the SMES charges from unused available generators.

Two point can be made concerning SMES:

--The key issue is the high 98% efficiency of the storage system.

--Its high cycle efficiency and fast response time also allows SMES to be used to improve system efficiency during periods when the load is changing.

ELS USE OF SMES

SMES is being considered as an ELS power supply. Dr. Henry Kolm suggested that ELS could propel large payloads such as supplies for a space station, which could have many commercial and defense applications. Since heavily loaded space vehicles require tremendous amounts of fuel for thrust at launch, the use of SMES as the power source at launch would decrease the weight of space vehicles considerably because they would not have to carry as much fuel.

The SMES is built underground. For a launch site, the ELS could be built on a mountainside to fire the vehicle off at an angle. The SMES would deliver high power during the launch; the rocket could then carry less fuel and more payload.

Much more will be said about SMES in the near future. They can make our power systems much more efficient, and, as the experience with SMES increases, ELS use of SMES could be substantiated. We will be able to fire larger and larger payloads into space; soon manned missions may be boosted into space using SMES. "Mankind has an innate desire to occupy all available space," says Dr. Kolm. "The questions left to answer are: when and where?" □

Is There Life After College?

Alumnus Jim Ross is instrumental at TI

by Jerry Dicks

Jim Ross is a 1985 graduate of UW-Madison. He received a bachelor of science degree from the Industrial Engineering Department and is now an employee at Texas Instruments in Lewisville, Texas. Recently, Jim took a break from his busy schedule to talk with us about his life after graduation.

Q. Jim, what is your position at TI?

A. I'm a Factory Planning Engineer in the Industrial Engineering Department of the HARM Missile Program.

Q. What are your responsibilities/duties?

A. I'm in charge of systematic layout and design of a 15,000 square foot area. My specific duties include assembly flow, automation, material handling, computer simulation, and inventory schemes.

"I took interviewing very seriously in college. After all, I was going to school to get a job, right?"

Q. Are you doing the type of work you planned on when you got your degree?

A. Yes, although it took me a year to get to what I'm doing now. I started out developing an electrical assembly training program for four months and then was a capital procurement engineer for eight months. Both jobs were interesting but not what I really wanted to do.

Q. In school, were you exposed to the techniques and methods you now use?

A. Basically, yes. General engineering concepts and problem-solving approaches were learned at school. Specific job skills were learned at TI.

Q. Did you participate in a training program? What was it like?

A. Most training was informal and taught on-the-job. There was no formal training program for the first six weeks, for example. Training was more "as you need it." A portion did consist of training programs, which included quality circle member and leader training, statistical process control training, time management training, basic management training, and a few others.

Q. How many companies did you interview with? What was most helpful in preparing for those interviews?

A. I took interviewing very seriously in college. After all, I was going to school to get a job, right? I sent out 75 letters to employers prior to interviewing. I interviewed with over 30 companies on campus, which resulted in 14 plant trips. Out of those plant trips came ten offers for employment. Those ten included IBM, 3M, Alcoa, Oscar Mayer, and Texas Instruments, among others.

Some of the things I did to prepare for an interview were carefully planning my resume, researching the company, coming up with questions for the interviewer, going to company information meetings and showing a genuine interest in the company, utilizing the Placement Office and taking Professor Marks' Career Orientation class.

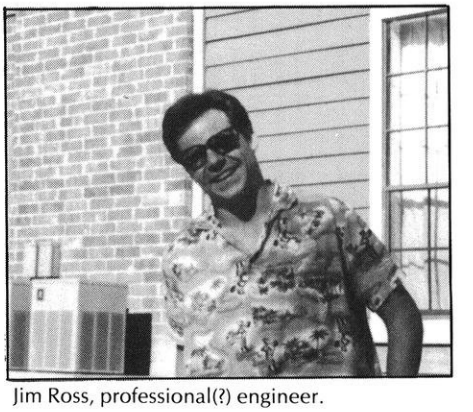
Q. What were your priorities when considering a potential employer?

A. I used the following criteria:

--Job responsibilities
--Job variety
--Career growth
--Job mobility
--Future of the company
--Company training program
--Use of high technology and computers
--Working conditions
--If company offered tuition reimbursement
--What the city/area is like
--If continued education was offered in the area
--People/Co-workers
--Stress/competition on the job
--Amount of travel required
--Relocation
--Company benefits
--Company reputation/status
--Take-home salary
--Cost of living in area
--Gut feeling

Q. Does your company encourage continued education?

A. Yes. TI offers 100% reimbursement for public schools and 80% for private schools. I attend the University of Dallas, a private graduate school, where I'm working on my MBA in Engineering Management. I watch my courses on closed-circuit TV. I attend class at work and watch my professor teach on campus, live. I have always been interested in engineering management and enjoy my classes.



Jim Ross, professional(?) engineer.

Q. What was the biggest change you experienced when you made the transition from student to engineer?

A. Responsibility. School is more relaxed--sleep in and skip class if you want, party your brains out, etc. School also gave you graded papers and lots of feedback. Work is different. I am responsible for laying out several hundred thousand dollars of equipment and automation for which there is no exact answer. There are no answer keys or old tests to look at.

"School is more relaxed -- sleep in and skip class if you want, party your brains out, etc."

Q. What do you enjoy most about living in Texas?

A. Big city life. Major league baseball, football, and basketball all in the same city, warm weather nine months out of the year, nearby lakes and parks, etc. And of course the incredible night life, expensive cars, and beautiful women ...

Q. What do you miss most about Madison?

A. Gyros at the Parthenon, State Street, drinking beer at the Memorial Union, the Madison lakes, my old friends....□

Some thoughts abou

From the Class of '85.

"Seattle and Boeing are good neighbors — 75,000 Boeing people live and work within 30 miles. I came here cold. No credit. No family. But when I told Seattle people I was with Boeing, they said: 'No problem.'

"I knew I'd like the strength and stability of a big company. What I didn't expect was a sense of 'family.' People here take care of each other — they're considerate. I know several Boeing people who have sons or daughters also working here. I think it says something about a company when a parent recommends it to his or her child.

"I'm in materials technology, primarily aluminum lithium. The immediate challenge is preparing for a 7J7 materials selection review this fall.

"What would I tell the class of '87? Well, tell them Boeing wakes up early. In my senior year, my first class was at 10. At Boeing, we've done a day's work by then."

Linda Rini
Engineer for Boeing Commercial Airplane Company.

your future. And ours.

From the Class of '49.

"Here are three advantages of The Boeing Company I think are very, very important.

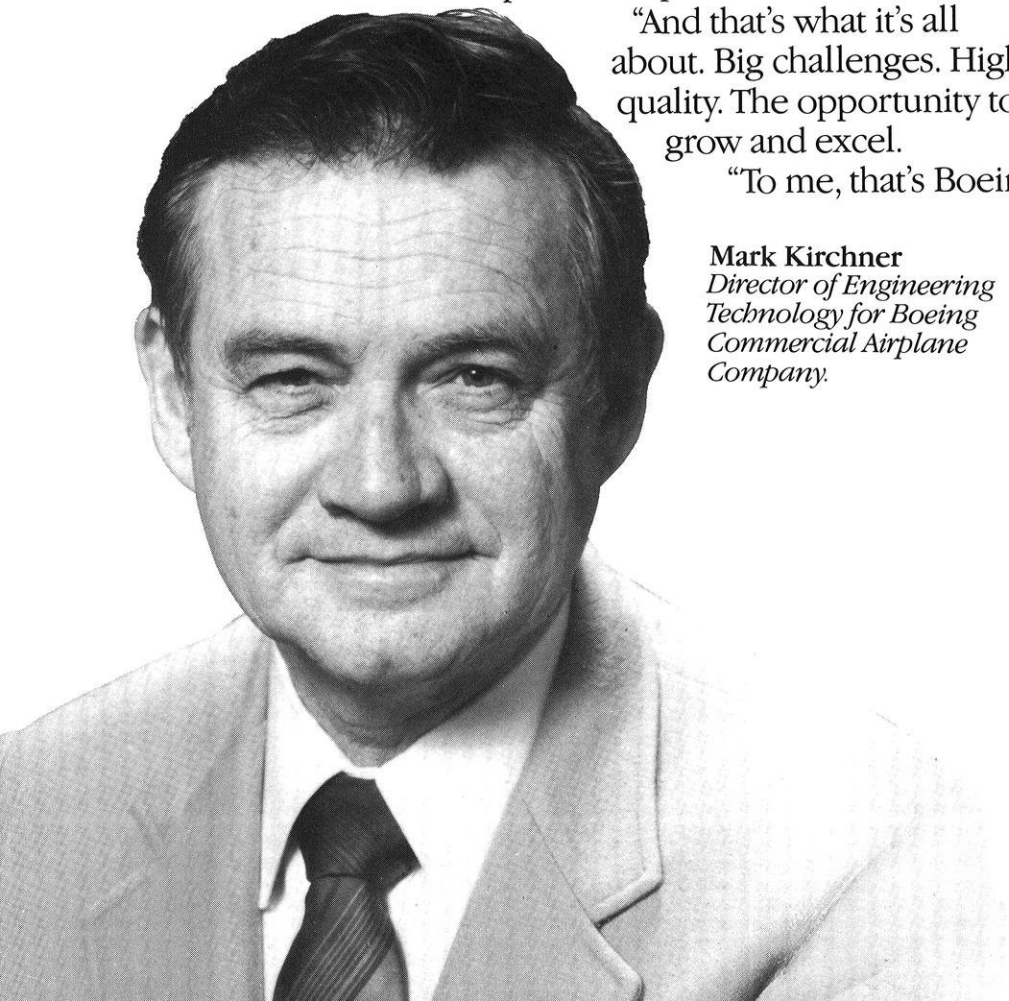
"First, flexibility. There are five major Boeing companies that have operations in the Seattle area. That creates a broad range of career options, and you don't have to move far or lose your benefits to take advantage of them.

"Second, Boeing quality is recognized around the world. We want people who can maintain and enhance that reputation.

"Third, there are exciting engineering challenges — the 7J7, new propulsion systems, new applications of electronics in fly-by-wire and fly-by-light. I suspect there are more challenges for computer specialists and EEs here than at most computer companies.

"And that's what it's all about. Big challenges. High quality. The opportunity to grow and excel.

"To me, that's Boeing."



Mark Kirchner
Director of Engineering Technology for Boeing Commercial Airplane Company.

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KWAP

Some of the OTHER aspects of co-oping

by Scott Paul

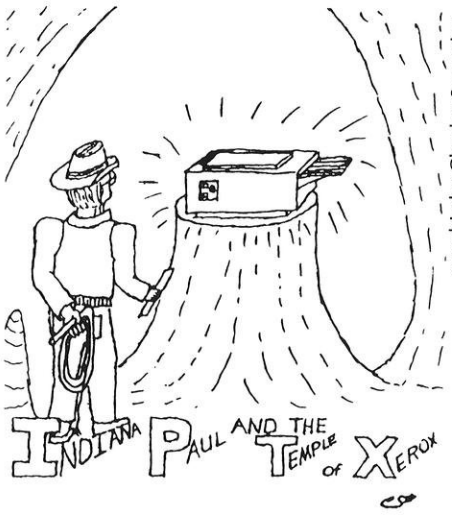
Students with co-op (pronounced kwap, after the sound of something hitting a fan) experience are perhaps even more sought after than students with 4.0's. Employers like to see students that have some experience in their field, however; there are many aspects of co-op experience that have little or no bearing on engineering and probably should not be brought up during interviews.

The first month of my co-op was the "don't know nothing yet" phase of my career. In addition to doing intensive reading about job-related stuff I also received valuable xeroxing experience. I can now collate, staple, de-jam, and wait in line like nobody's business.

As an engineering student I often had to pass up going to a Badger game in order to work on a lab or homework set that seemed more important. But as a co-op student in Columbus, Ohio, it seemed more important to defend the honor of Wisconsin from all attacks from non-Badgers. "Not only are our games more fun," I stated, "we also have a better band." I didn't go so far as to state that we had a better football team, but when the Wisconsin-Ohio State game came around (Ohio State was favored by 21.5 points) I covered bets from anyone who gave at least 15 points. I was so proud of my team when they won. I think that experiences like that are what inspire alumni to donate gobs of money to the university.

The first month of my co-op was the "don't know nothing yet" phase of my career.

I learned most of the details of office politics by listening to conversations in the company cafeteria. Here one could learn who had their resume on the streets, who was having a secret romance with whom, and who was on the "good" list and who was on the "bad" list. Not all the conversations were about interesting stuff like that; however, a lot of them were just about how bad the cafeteria food was. I had eaten at Gordon Commons for two years and had been eating Kraft Mac & Cheese for the last year, so I often even had double entrees at lunch. I pretty much just stayed out of those particular conversations.



graphic by Charles Spengler

One thing that I took home from my co-op that I didn't expect to was a southern accent. Ohioans don't talk so funny, but my roommate was from West Virginia. When I returned to Rice Lake, Wisconsin, my speech was full of drawls and y'all's and whatnot. I was accused of not being a Wisconsinite anymore--until I caught more walleyes than my dad on a fishing trip.

At UW-Madison the only time I ever missed not having a car was when I needed to make a Cub Foods run. I worked one semester without a car and took the bus to work. I met several interesting people on the bus in the big city, some of whom talked to themselves; nevertheless, I felt that after my first co-op period I could afford a car for the next one. This is when I became acquainted with the "real world" practical experience aspects of co-oping, i.e. making payments. Also, two of the most valuable lessons I learned the hard way were (a) don't get your car fixed at a garage in a bad part of town, and (b) always get two estimates before having any major work done.

My co-op job also exposed me to another aspect of real world concerns--paying taxes. Apprehension about changes in the tax code became very real to me, and I found myself discussing deductions and loopholes with other engineers in the company cafeteria. When I worked at McDonald's they took money out of my paychecks, but that was just for fun; I knew that I would get it all back at the end of the year. This time Uncle Sam was playing for keeps.

Most engineers can't avoid the tax bite, but many try to compensate by finding profitable ways to invest their surplus income. More than one engineer had a story to tell about an investment gone sour--and by the end of my co-op, I also had found a hot item to invest in. After I pulled my remaining funds out of the market I felt a little better about watching the company finish its nosedive into bankruptcy.

My co-op fortune may have been whittled down, but my engineering experience was the most valuable thing that I got from co-oping. And that was something that no stock market crash or unscrupulous auto repairman would ever be able to take away.

Some of the more serious aspects of co-op experience were also valuable. I did get to do real engineering; my projects are still being used by the company I worked for. I learned a lot--there was always someone who would answer my questions; it was kind of like being the only student, but with ten professors around to help explain things. And the money I earned helped me get through school and kept me from spending summers flipping burgers.

My co-op job exposed me to an aspect of real world concerns -- paying taxes.

A co-op program is probably the best thing a student can get involved in if he or she is interested in pursuing a career in engineering. An engineering summer job is probably the second best thing to do. If you are interested in co-oping or finding a summer job stop on up and visit with the nice people in the co-op office on the fourth floor of the Kurt F. Wendt Engineering Library. □

Transferring: Troubles and Triumphs

Eunice Hoffman retires after 37 years as transfer advisor

by Sue Sartain

"It was challenging and it was interesting," reflects Eunice Hoffman on her years of work as Educational Services Assistant. After 37 years with the College of Engineering, she retired this past summer.

As Educational Services Assistant, Hoffman was in charge of accepting or denying engineering transfer students, both those returning to school and those applying from other schools. Admittedly, the job required much "red-tape" knowledge: who could enter, upon whose authority and under what circumstances. Yet, for Hoffman, the job was far more lively and rewarding.

"It's very satisfying to see students succeed. You feel personally involved."

Hoffman recalls the story of a 40-year-old student on the GI bill. This student worked full time and attended school part time, maintaining a grade point average of nearly 4.0. Upon transferring, he sold his home and moved his family to Madison. Correcting papers as a part-time job and studying during most of his time off, he finally graduated. "He was a real go-getter," Hoffman remarked, "and it's very satisfying to see students succeed. You feel personally involved."

There is another side, though. Hoffman often had to be the first to tell students they were denied admission. "They beg. They plead. When you do explain that the competition is ruthless and they probably wouldn't succeed, they usually realize it's true. Seldom do they go away mad." But this was not so, she related, in a most unusual case where a student was once denied admission by a former dean. Rather upset, the student followed the dean into the parking lot and clung to his car in desperation.

Perhaps the most tragic story Hoffman has to tell is that of a foreign student whom Hoffman admitted under pressure from a department and against her better judgement. After a family member was badly hurt in an accident and the student couldn't finish his lab work, the student took cyanide over Christmas vacation. Hoffman sighed, "I feel, in a way, somewhat responsible."

"I think I was hired out of desperation."Hoffman explains that the College needed someone who could take shorthand, who had graduated from Wisconsin, and who was old enough to deal with the many vets who were returning. One of the most remarkable things Hoffman has seen over the past 37 years is the change in acceptance standards. In 1949, a C average was enough to get into any department. Because of increased enrollment, each department has adopted a grade point minimum.

Another great change has been in the enrollment of foreign students. The College of Engineering cannot limit admission. It cannot turn anyone away on the basis of country, color or sex.

"They beg. They plead. When you do explain that the competition is ruthless and they probably wouldn't succeed, they usually realize it's true."

Foreign students are often the most agreeable. "Perhaps it's because they don't know anyone else. You are their first contact; they depend on you," she said, adding that many foreign students came to her first with their academic as well as personal problems before resorting to the Dean.

photo by Paul Driessen

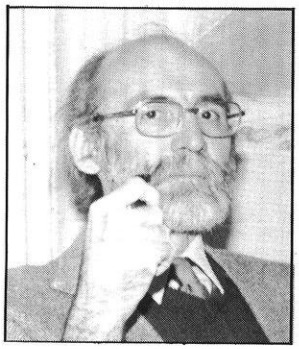
Eunice has college catalogues from all 50 states and several countries.

What about life after retirement? Having earned her degree in home economics, Hoffman enjoys designing her own clothing, sewing, canning and gardening. Bow and rifle hunting are also favorite pastimes. Being treasurer of the Library Board, participating in church groups and spending weekends on a jointly owned farm have kept her busy and active. She laughs, "It's as one student once said, 'Now I'll have time to practice my home ec.' " □

Yes, No, Maybe?

by John Oghalai photos by Paul Driessen

This summer, a forum was sponsored by the General Engineering Department on the Strategic Defense Initiative. I spoke to professors in the engineering department to get their opinions on the SDI, and to discover the basis for these opinions. I also selected an assortment of quotes from student research papers written about the Forum. These interviews and quotes were selected to show some of the opinions held by people in the engineering college regarding the SDI.

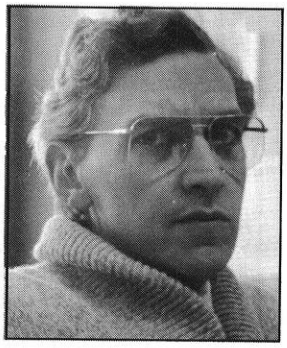


Professor K. E. Oughstun, ECE

Professor Oughstun spent seven years in industry working on lasers, one of the key areas of SDI research. "There are three major breakthroughs that need to occur before the SDI could go into effect. Engineering just hasn't reached that level yet." He believes that, regardless of the technology developed, SDI will not work. "It has a flaw--it's indefensible. It would take years to put all the equipment needed into space, and the Russians would shoot it down, piece by piece, as we put it up."Yet Professor Oughstun feels that the research for SDI is necessary, since the knowledge uncovered would have great applications elsewhere. Besides, the Russians have been working on their own defense program for years. "At best, we are even with them. There could be as many as four or five years difference between us." Professor Oughstun would choose not to start building the SDI now, though. "President Reagan hasn't thought it all out yet. It's feasible--but not practical."

Professor B. E. A. Saleh, ECE

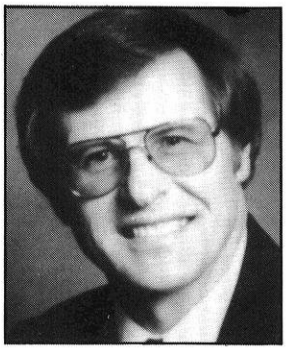
Professor Saleh opposes building SDI as a matter of principle. In addition, he says it would be extremely difficult to implement. "SDI involves a combination of many unproven technologies, which could render the probability of failure unsafely high, thus defeating the main purpose of SDI." Professor Saleh feels it would be better to open channels of communication with the Soviet Union rather than to work on SDI, thus inviting them to take escalating counter-measures. "Universities should not work with the military on expensive and futile technology. They should instead put their limited resources to more useful research in, for example, medical technology and ways to feed more people."



Professor J. D. Wiley, ECE

Professor Wiley is not impressed by the "Star Wars" program so far. He says flat out that the SDI system described by Reagan as a 100% effective shield would not work. Some missiles would still get through. He does feel that some parts of the proposed system may be feasible. "The concept of detecting a missile right after it is launched and destroying it in its boost phase with a laser shot from the U.S., which had been reflected from a satellite mirror in space, is very challenging but perhaps possible. The shock wave created by an intense laser pulse could destroy the missile during this most stressed period." The ability to detect the missile early enough is "do-able." The super-high powered laser needed is "iffy," but technology is not yet advanced enough to develop a real-time control mirror satellite. The SDI isn't the way to stop the real problem anyway, says Professor Wiley. "There are so many other ways that an adversary could attack us. For example, one gallon of a toxin dumped into the open New York City water reservoir could kill millions. This water is so clean it isn't even filtered. I would be much more concerned about simple, low-technology attacks than about blatant launches of hundreds of missiles from Soviet soil."

Students and professors sound off on the SDI



Professor G. L. Kulcinski, NE

Professor Kulcinski believes that the U.S. scientific community should investigate the feasibility of the SDI. "There is nothing wrong with learning about protective systems." After developing the technology needed for the SDI, the deployment issue can be addressed. Professor Kulcinski describes the SDI as "not a single device, but a series of systems of devices. But if both the U.S. and the Soviet Union had an SDI system--yes, it would reduce the threat of nuclear war."

Robert Apthorpe, NE 3

"Of all the questions facing the SDI system, those of a technical nature will probably be the easiest to answer since, for example, it is much easier to test a laser than to see what the Soviets would do if we deployed an SDI system."

Guy Peterson, BS 4

"SDI is a dangerous program costing our country more than money. It should be abandoned before it does our country great harm."

Robert Holewinski, BUS 4

"I hope the research for advanced weapons is approved because the U.S. depends on our superior technology to combat Soviet quantity (of weapons). But SDI will neither promote global stability nor help to curb the arms race."

Allan Stange, AMP 4

"Speakers used widely varying estimates for such things as the cost, number of launches required to put an SDI system in place, explosive power of a laser beam and the size of the battle management program. When the experts disagree so wholeheartedly, it is difficult for the average person to come to a conclusion on the salient points of an argument."

Steve Byrnes, ECE 3

"SDI should be researched with the hopes that a simple and low-cost defense system can be developed."

Todd Connell, BS 4

"It seems escalation (of the arms race) is the third thing you can count on in life, along with death and taxes, which, ironically, might be the only things that (SDI) is going to give us."

Greg Cornelius, ME 2

"I believe SDI is a necessary evil which, if we are resourceful enough, will provide us with many products that will be useful in other fields. We are on the verge of a new era that may possibly open the vast frontiers of space. If we can manage to begin moving towards world-wide cooperation and negotiation, this distasteful beginning may lead to a very bright future."

A Badger Turns Crimson

The first year at Harvard Business School

by Will S. Kenlaw, BSIE 1981

It seems like only yesterday I was sitting in the ME building trying to get my linear program debugged before class. Amazingly, that was five years ago. Now I am back in the classroom. But rather than sit peacefully and listen to the next lecture on stochastic variables or deterministic equations, I must convincingly debate with fellow classmates the best way to finance the expansion of a business or implement a new marketing strategy.

This is graduate business school--HARVARD style. More businesses are dismantled and more people are fired at the Harvard Business School (HBS) in one week than in the last century in the "real" world. This is all done in the classroom and in the interest of learning, mind you. The philosophy is to give a student a crash course on a company and its problems (otherwise known as a 5- to 30-page case study), and the next day make the student the manager or executive who must solve the problems.

For those who wonder what it is really like, the best example is the movie, "The Paper Chase." There are ninety people per classroom and the Socratic method is employed. In other words, the professors do not lecture. They orchestrate the discussion, control the pace. The cases each have critical lessons and information that should be communicated to the class, but the random variable is the student. Each is an individual with unique knowledge, experiences, and sometimes, expertise. One learns from the eighty-nine other souls in the classroom.

A FIRST TASTE

As you might imagine, the first five or six weeks are incredibly intense. You enter "the twilight zone." It is an adjustment period. How many hours does it take to prepare a case study? How many days can I go with only three hours of sleep? Why is everyone more prepared than I am? How can I possibly be prepared every day? The answers are: infinite, many but not productively, they aren't, and you can't!

This madness is actually intentional. In a sense, it mimics the real world. You can not accomplish everything in a day. Therefore, you must constantly make decisions on what is most important and what can wait another day. By the middle of the semester, you also decide what is important to you--grades, family time, socializing, enjoying the experience. Finding the balance is very important.

THE ENVIRONMENT

The environment is somewhat charming and conducive to learning. For those of you who must know, the building walls really are covered with ivy. The campus is beautiful and is separate from the rest of Harvard. (HBS is on the Boston side of the Charles River.) The MBA program is two years long, and there are approximately 1500 candidates enrolled.

The first year is rigid and rigorous. There are no electives. The 750 or more people entering each year are divided into nine sections. First-year students will take classes only with their section of ninety students in one classroom the entire year. The second year is comprised of nine and a half electives and one required course. Classes are held five days a week, except the second semester of the second year when they are held four days a week to allow time for interviewing.

The classrooms are tiered so the professor can see all the faces and name cards. It is a kind of "mini-auditorium" style. There are thirteen cases per week. There is also another interesting twist to the teaching method. Students are usually "cold called" to open a case at the beginning of class. In other words, one never knows when one will be called upon; therefore, one must always be prepared. It adds a twinge of excitement to every class.

THE PEOPLE

The biggest surprise is probably the people. Most are down to earth, hardworking, nice people. Contrary to popular belief, there are not many snobs. True to popular belief, there are a lot of very intelligent people. The competition in the classroom is keen but not cut-throat. It is also often fun.

There is no denying the fact that most of the people are "high steppers" or over-achievers. What is interesting is how it manifests itself in the classroom. Over-achievers try to distinguish themselves from their peers. But what happens when all your peers are over-achievers? Some become more creative. Others strive for eloquence. Still others search tirelessly for that case-breaking fact (it usually doesn't exist). Some "crunch the numbers" to the Nth degree and stress the quantitative. And others throw away the numbers and push the qualitative issues. In sum, over-achievers can not turn off the achievement valves, but at HBS the class as a whole benefits from this pushing of the limits.

They come from all over the world. Every major educational institution is represented as well as many smaller schools. However, there are a lot of ivy-leaguers. For example, my class has twenty-seven people from Princeton and twenty-four from Yale versus six from UW-Madison and ten from Michigan.

AN ENGINEER'S PLACE

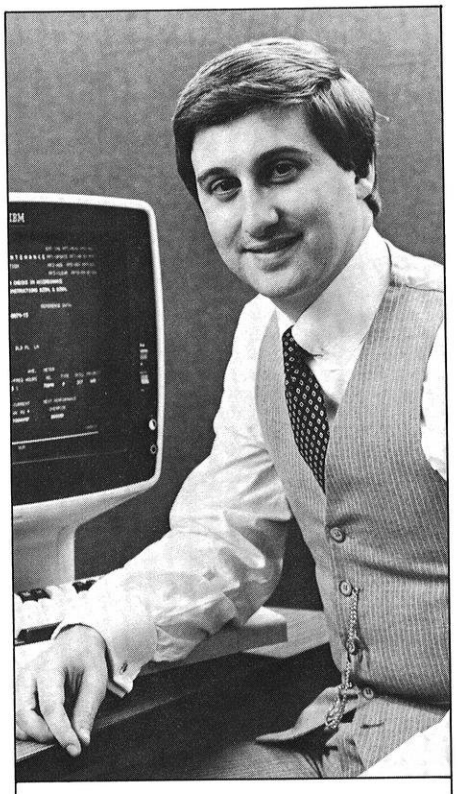
Engineers actually fit in well at HBS. Twenty to twenty-five percent of the students have undergraduate degrees in engineering. That may be surprising when compared to the ten to fifteen percent of the students who majored in business. In addition, the traditional "tough" courses are also quantitative. This gives the engineer an advantage. With all the bright people at HBS, any advantage is a welcomed one.

The work experience of most engineers is a big advantage at HBS. An engineer's first job is usually a "real" job rather than a service-related job. Engineers often work in manufacturing or production, where the work actually gets done and line management is often the route for advancement. Since many of the cases are written about basic business operations and problems, the engineer's perspective is a particularly valuable one in class.

HBS utilizes personal computers for some case analyses. Each student must own one and be familiar with its operation. This is a natural for most young engineers today since computer skill is required in most accredited curriculums.

All in all, an engineer is in good company at HBS. If you are an engineer with a business interest on the back burner, then investigate HBS. After all, you have nothing to fear but 800 cases and a well-earned reputation. □

Follow In Their Footsteps



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.

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.

Oscar Mayer

Oscar Mayer Foods Corp.
Corporate Recruiting Office
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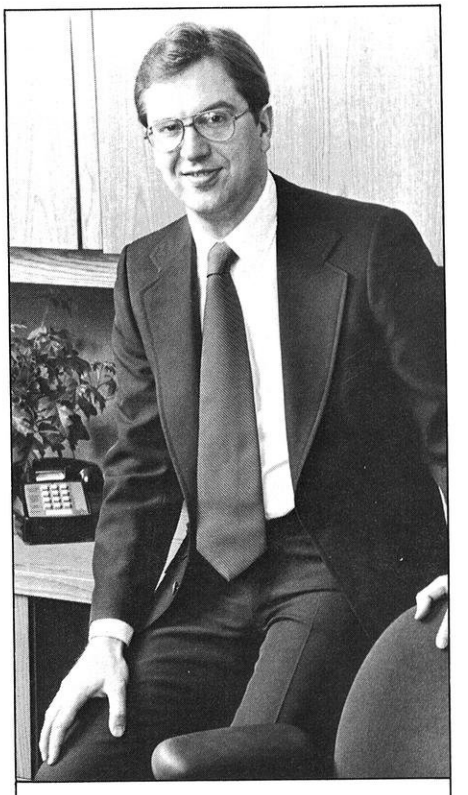


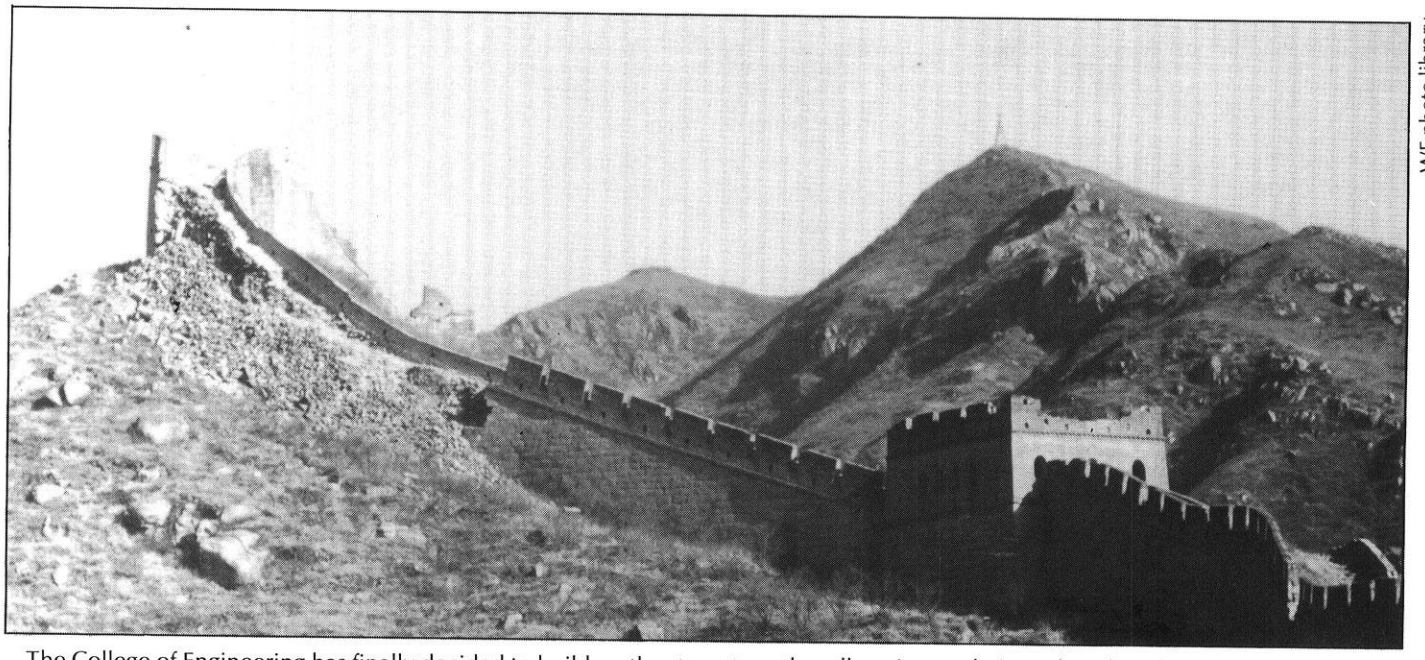
Pat Molitor
Plant Engineering Manager
Davenport Oscar Mayer Plant

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.

Just One More
The Great Wall of Engineering

by Gary Webster



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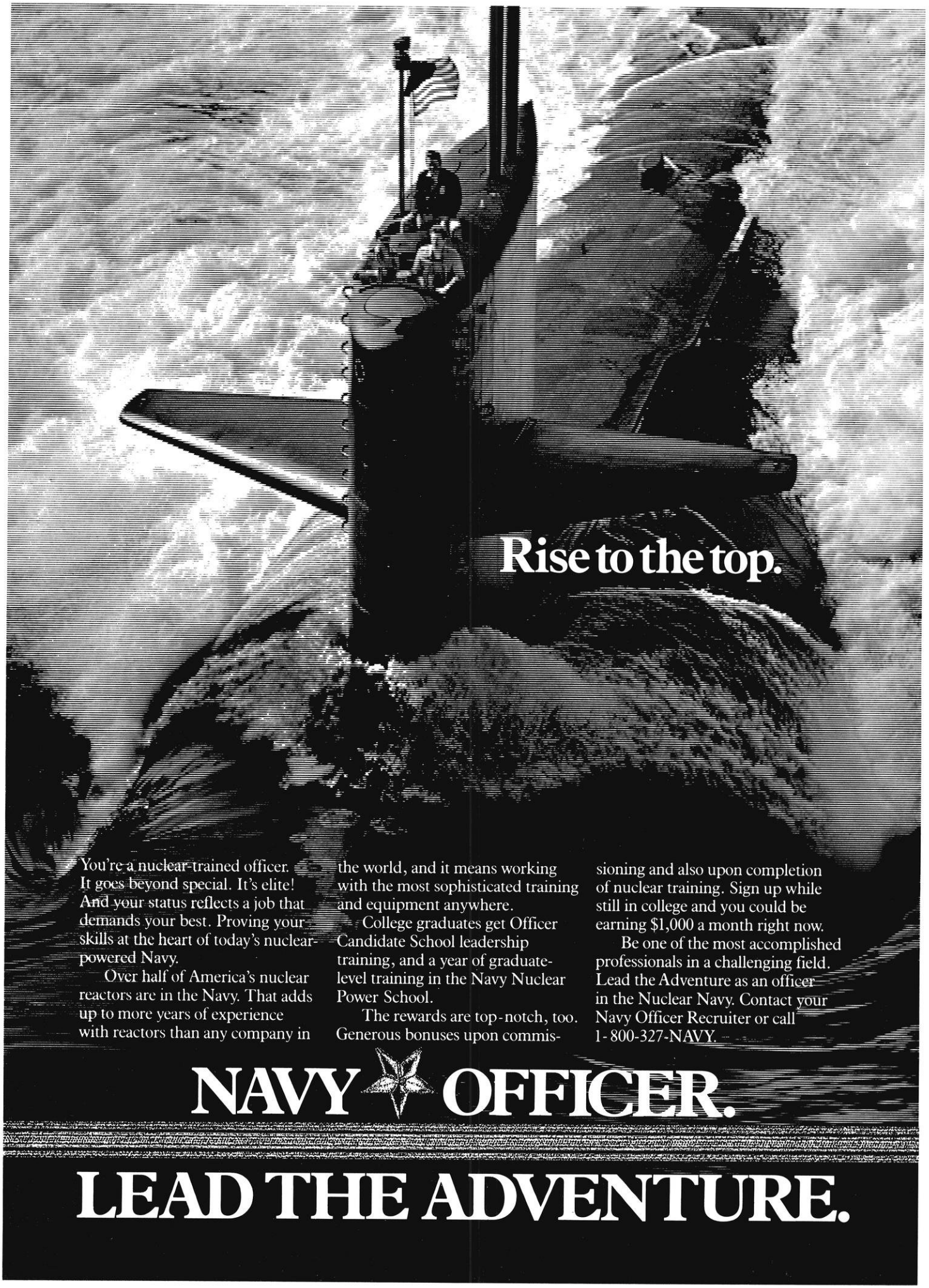
The College of Engineering has finally decided to build on the stereotype that all engineers do is study. Therefore, the College has decided to purchase a section of the Great Wall of China and erect it around the engineering campus, thus preventing engineering students from having any kind of social life. Shown here is a section of the Great Wall being dismantled. □



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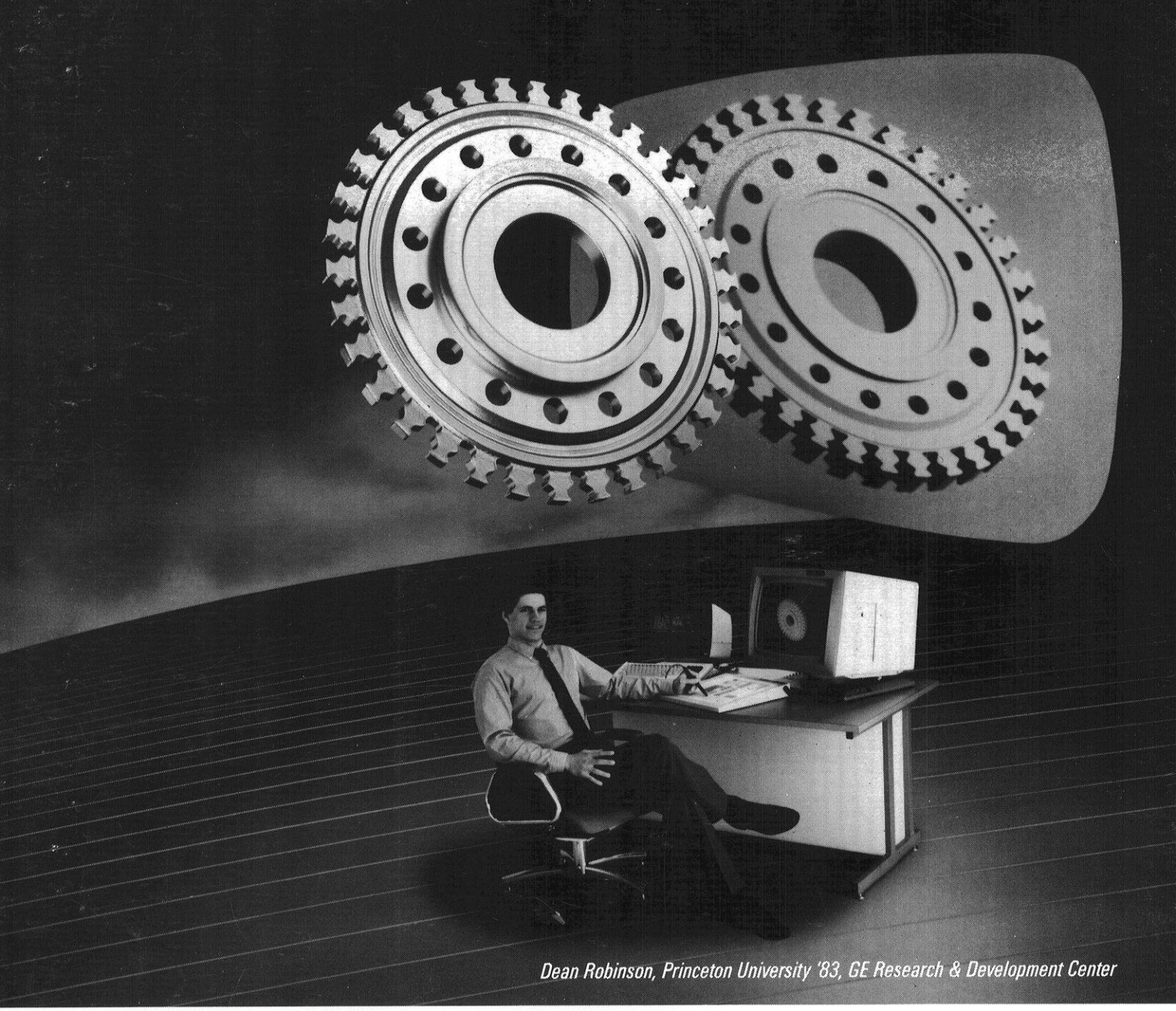

Dean Robinson, Princeton University '83, GE Research & Development Center

Zip Your Idea From Art to Part

At tomorrow's GE, young engineers like Dean Robinson will produce designs almost as fast as they can think. Thanks to newly developed GE software that transforms design data directly into a tool path to produce the part right from an engineer's workstation.

The new technology, called "art-to-part CAD/CAM," goes far beyond solid modeling. First, realistic images are generated and displayed on the terminal; then tested, stressed, and refined. Designs can be rotated, cross-sectioned, or peeled away in layers. But that's just the beginning.

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What puts GE so far ahead in the development of art-to-part CAD/CAM? Perhaps it's because we're our own best customer. We don't just design the software. We don't just build the hardware. We use these systems in most of our businesses. So we're constantly getting feedback from our own engineers. Feedba that inspires ever more intelligent useful workstations.

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