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A $50,000 Corvette

Australia

Computer Viruses

Composites

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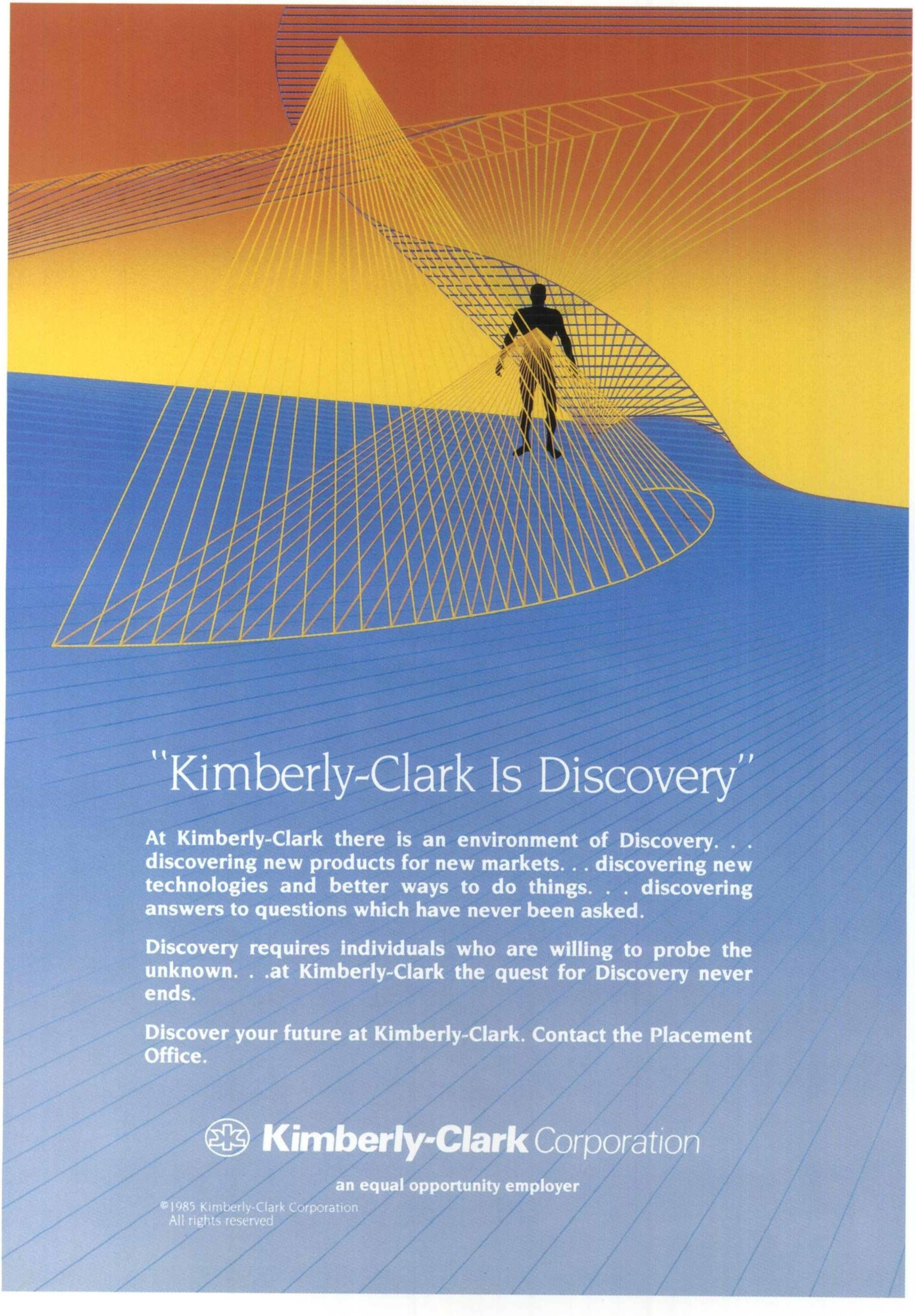
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wisconsin engineer

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EDITORIAL

Searching for a job can be a very frustrating experience, especially when you feel that departments designed to assist you don't understand or meet your needs.

Engineering Mechanics students (EM's) have often had these feelings regarding the Career Planning and Placement Office (CPPO). Their frustration is largely a result of problems in signing up for interviews. Under current rules, only students majoring in the disciplines that a company specifies are eligible to sign up for interviews. And usually, EM, which is an uncommon major, is not the first box that companies check when returning their hiring preference forms to the Placement Office. More often it is Mechanical Engineering, Chemical Engineering, or Electrical and Computer Engineering that interviewers specify.

Upon close examination of the situation and conversation with CPPO Director Sandra Arnn and Engineering Mechanics Department Chairman Phil Kessel it can be seen that the problem is not really with the CPPO, but with the education of industry in general. The CPPO has been extremely cooperative in helping to promote Engineering Mechanics, especially since Sandra Arnn took over as director last year.

First, a look at statistics reveals that the CPPO does not have a bad record of placement of BSEM graduates. Last year 52 students received Bachelor of Science degrees in Engineering Mechanics. Of the 45 that registered with the CPPO 10 went on to graduate school and 33 accepted offers. Only two are still seeking employment, which is a low figure compared to the other engineering departments. In constrast, ten Mechanical Engineers, nine Industrial Engineers, and nine Electrical and Computer Engineers are still seeking employment.

Another question to be answered is do EM's get as many offers and interviews compared to other engineering departments? Information from the Placement Office appears good, comparing EM to Mechanical Engineering (ME). Last year EM's received an average of 1.9 offers per student and ME's received an average of 2.1 offers per student. These averages look pretty compatible considering that ME is more than twice the size of EM.

So, if the CPPO seems to be doing a good job of placing EM's why do EM students still feel frustrated? According to Kessel, the problem lies with recruiters not more actively seeking EM students due to the lack of industry education as to what Engineering Mechanics is. In many large companies hiring quotas are sent down to personnel or human resource offices. They usually say we need 10 ME's, 5 IE's, 3 ChE's, etc. Since Engineering Mechanics programs are not widely known, graduates are not sought after, even when an EM might be just what the company is looking for.

There is also not much consistency in similar program names around the country. In many universities, Engineering Mechanics is a division of Mechanical or Civil Engineering. Also it may be separate, as it is here, or it might be called Engineering Science or Engineering Physics. This diversity may lead to a mistaken sense of what Engineering Mechanics is at UW-Madison.

The CPPO and Kessel have been working together to help solve this problem by sending letters and information about the EM program and what it involves to the companies that interview here and to all prospective companies that might hire EM's if they knew more about them. But as Kessel comments, "We can write all the letters we want, but if it doesn't get to the right person it doesn't matter. And it's very difficult to get it to the person sending down the hiring quotas." Unfortunately, many of these letters may be received by the personnel office and filed, not passed on to the people setting the hiring requirements, even though many of the letters have been intentionally addressed to the companies' engineering departments.

Arnn and CPPO Assistant Director Helen Richardson have taken this one step further by personally contacting prospective EM recruiters and explaining the EM program. Arnn says that in one incident last year, a recruiter told her he was "sick and tired" of all this EM information being presented to him. He was only interested in ME's.

It has been suggested that anytime an ME is requested that EM's be allowed to sign up for interviews also. Both Kessel and Arnn disagree with this idea. Kessel feels that EM and ME are such different programs, EM being more design development oriented, and ME's focus being on design, that EM's would not be happy in ME jobs and vice versa. Likewise, Arnn states that since interviewers adhere to strict hiring quotas of certain engineering disciplines, letting EM's sign up would not satisfy their requirements and antagonize companies. She feels anything that would antagonize companies might cause them to not come here to hire anymore, losing job opportunities for other students.

Another idea being considered by the EM Department is a department name change to "Applied Mechanics and Astronautics." Kessel says, "Applied Mechanics means a lot more to people in industry." It would also make the space research and Astronautics Option program more visible to companies hiring in this area.

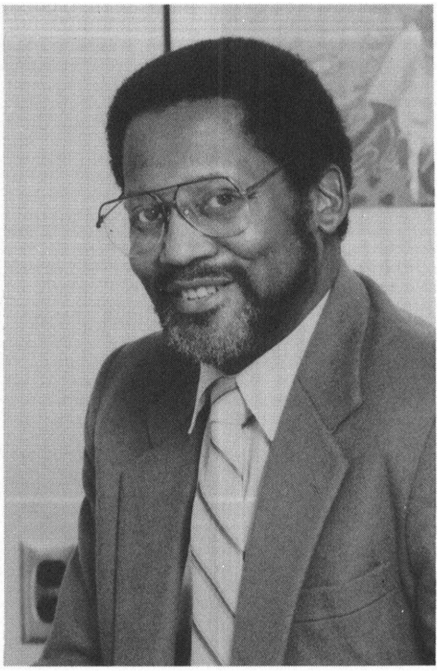
Kessel is optimistic about the situation and feels it is improving tremendously. The enrollment in Engineering Mechanics has doubled in the last ten years from 96 undergraduates in 1978 to 204 this year. The department is graduating more and more students who advocate the program and spread the word about EM graduates' capabilities. This gives the department more exposure and educates industry.

The CPPO realizes the frustration experienced by EM's, and is making many efforts to expand exposure of the program in industry. Expansion of this effort has also reached the Co-op Office where Co-Op Director Marion Beachley is seeking to expand the number of EM hirers. With a continued commitment by the College of Engineering and the CPPO with Director Sandra Arnn to promote the hiring of EM's the situation should improve even more.

- by Barbara Angermann, Co-Editor

Dean's Corner

Ethnic Studies For Engineers?



Does it make sense? You betcha.

I once had a sociology professor who loved to quote this expression to his class: "Most people are down on what they are not up on." I believe that requiring an ethnic studies course would begin to put us "up on" that which many people are now "down on": anyone with a different ethnic background. The penalty for being "down on" other cultures is too stiff. I'd like to discuss the seriousness of the problem, and how an ethnic studies course presents at least the first step toward a solution.

As we move closer to the 21st century, certain predictions of the past few decades appear to be coming closer and closer to fulfillment. For example, fewer students are finding engineering attractive as a career option (see "Ominous Trends in Engineering Enrollment," Wisconsin Engineer, July 1988). Right now we are facing a shortage of engineering and science faculty at our institutions and the situation is not getting any better. It is predicted that there will be a shortage of 560,000 engineers by the year 2020 if these trends are not reversed.

These shortages, if allowed to continue, will present a great threat to our national defense and economic security. The competitive edge we once enjoyed in the technological and scientific world is being seriously challenged by other countries.

So what does this shortage of engineers have to do with an ethnic studies course? In 2020, about 30 years from now, approximately 43% of the nation's population will be composed of minority groups. Blacks will constitute 18%, Hispanics 16%, Asians 6.5%, and other 2.5%.

Perhaps some of you are beginning to see the greater picture. Most of these minorities could be lost to the engineering and scientific profession because of racial tensions and discrimination. Also lost could be countless deals and propositions on the international business scene due to ethnic or cultural ignorance on the part of an uninformed manager, as more and more U.S. industries are forming partnerships with foreign businesses.

Can we as a nation afford to have 43% of the nation potentially excluded from helping solve our technological and human resources problems? Can we afford to have managers, vice presidents and business men and women make ethnic and cultural blunders caused by ignorance of the rest of the world's viewpoints, ethics and lifestyles?

I say no. As Assistant Dean and Director of the Office of Engineering Minority Affairs, I do what I can to optimize the chances for minority students to succeed in engineering. Based on enrollment figures and graduation rates, I feel that the UW-Madison College of Engineering has many opportunities for minority students interested in a career in technology. But I hear my minority students speak of isolation and unhappiness caused by inappropriate expectations of their predominantly White peers, professors and co-workers, and I see little that I can do about such a pervasive problem. My hope for the future lies in a required ethnic studies course.

It makes no sense to train engineers to solve technical problems but not people problems. Certainly, engineers (and engineering students) will need both sorts of skills for the 21st century. We can have world leadership in science and technology, or we can have racial divisiveness, but we can't have both. The success of this college, of this University, and this nation depends on effective strategies for dealing with and understanding people from diverse ethnic cultures and backgrounds.

An ethnic studies course may not solve all of the racism and discriminatory problems that we are facing in the public and private sectors of the nation and here at UW-Madison, but it will be a start. I sincerely believe that it will be a start to a better understanding and appreciation of the differences—and similarities—among various ethnic groups represented in the U.S. work force. Greater understanding and appreciation, of course, will foster better relationships, which will in turn allow the harmonious progress, that I am so "up on."

We all want to solve the problems facing us in the 21st century: not only the problem of fewer students entering the engineering and science professions, but also the communication problems that exist among the various ethnic groups. Doesn't it make sense to start now instead of waiting for a crisis? It is scary to think that today's entering freshmen are too young to remember the racial crises of the 60's—Watts, Washington D.C., Philadelphia, Detroit and many other cities where billions of dollars were lost due to riots and burning of businesses and homes.

Will the 21st century bring the same thing? Let's not let frustrations, tensions, and hate build up until that question is answered "yes." An ethnic studies course required for all UW-Madison students would be a start that makes good sense to me. It is something I am definitely "up on".

- by Alfred Hampton, Assistant Dean

Plasma—Aided Manufacturing

UW-Madison is on the Cutting Edge of Technology

- by Lisa Peschel

After four years of meetings, negotiations and rewritten proposals, the College of Engineering has achieved a major goal: the National Science Foundation (NSF) has chosen the University of Wisconsin- Madison as a site for a new Engineering Research Center (ERC). This designation brings not only acclaim and prestige, but a commitment of up to $12 million in federal funding. The College of Engineering will use this money, along with donations from the university, the state and industrial sponsors, to found the Engineering Research Center for Plasma-Aided Manufacturing.

If plasma research meets the expectations of the NSF and the College of Engineering, the ERC could pay for itself many times over. According to J. Leon Shohet, Chairman of the Electrical and Computer Engineering Department at the university and director of the new ERC, the market for plasma applications in industry is already worth $100 billion a year or more.

The Beginning

Plasma, sometimes called the fourth state of matter, is produced by adding energy to a gas. The energy first separates the gas molecules into their individual atoms, then strips the electrons away from the nucleus of each atom. The resulting plasma consists of ions, neutral particles and electrons.

Shohet has been working with plasma for years. In 1983, he was doing research on nuclear fusion. The fuel used for fusion research is a plasma made of hydrogen and its isotopes, heated to more then 10 million degrees Kelvin. Shohet needed specialized magnet coils for one of his projects, but didn't know where or how to have them made. He finally found help at the Physical Sciences Lab; this university facility can manufacture specially designed parts that cannot be purchased through normal channels.

Technicians there cut the coils out of metal using an industrial plasma process. For industrial uses, plasmas can be made of many different materials and are used at temperatures that never rise above a million degrees Kelvin. The process was new for Shohet, and for the people at the Physical Sciences Lab too; they had often worked with industrial plasma, but they had never cut such a complex shape before. After seeing what this plasma could do, Shohet realized there must be many applications for it in industry.

Soon afterward, the NSF announced formation of the Engineering Research Center program. By sponsoring research centers, the NSF aimed to enhance the international competitiveness of U.S. industry. The centers would bring together engineers and scientists from the academic community and from the private sector, and provide financial support for them to investigate new engineering techniques that could be applied profitably to industry.

With Shohet's encouragement, the College of Engineering submitted a proposal to found a plasma research center. The University had a lot going for it right from the start. Several traditionally strong research areas, such as plasma science, materials science, chemistry, physics, and manufacturing systems engineering, formed a foundation for the new center. Professors were already using existing facilities like the high-temperature lab and the particle technology lab for plasma research, and the College even found a building ready to house the new center: 1410 Johnson Drive, former site of the Highway Lab.

The Highway Lab Building- the center will share it with WCAM (Wisconsin Center for Applied Microelectronics).

The search for industrial sponsors yielded an immediate and enthusiastic response. Plasmas already played key roles in major manufacturing processes, and promised to play a much larger role in the future. Companies quickly offered funding and other aid.

The NSF was not impressed. The 1985 grants were awarded to six other universities.

The proposal was improved and revised. The College of Engineering invited the University of Minnesota to join in the proposal and complement some areas of plasma research where the College was not strong. However, the NSF passed up the proposal for two more years before the Dean of the College of Engineering, John Bollinger, decided to take more drastic action. He arranged a meeting with the NSF committee. In the summer of 1987, more than 20 representatives of industry and the University appeared to help convince the NSF of the need for a plasma research center. One of Shohet's experiences illustrated to the committee the threat of the Japanese and Europeans getting a jump on U.S. industry: last August, he attended an international symposium on plasma sponsored by 88 Japanese businesses. Out of the 600 people attending, only 38 were Americans.

On August 19, the NSF selected Wisconsin's proposal for a plasma research center, along with proposals from three other institutions for research in different areas, from a group of 66 applicants.

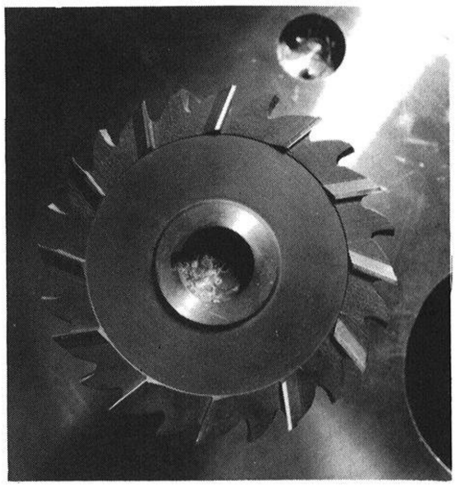
Plasma in Industry

One of the important industrial uses of plasma is called plasma deposition. The plasma is used to deposit material onto a surface to form an incredibly smooth layer that can be anywhere from a few microns to several centimeters thick. Sometimes the receiving surface is roughened so that the coating and the surface, or the heat of the plasma can make the atoms of the coating and the receiving surface diffuse into each other.

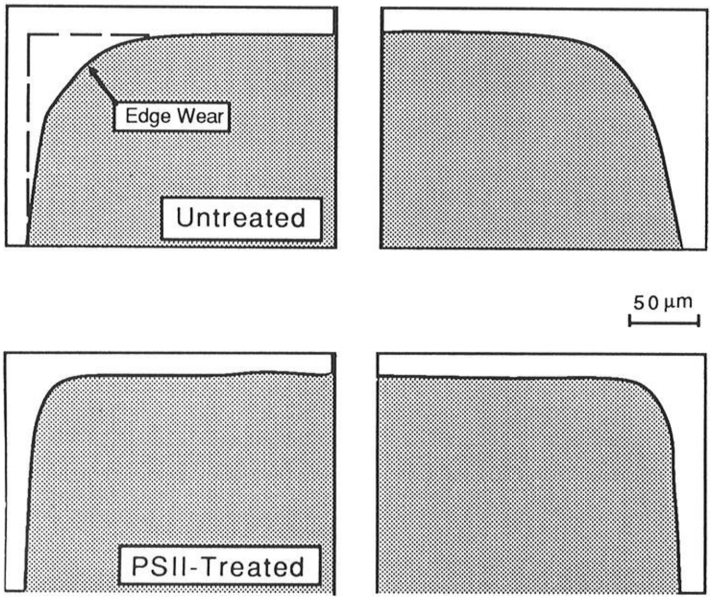
Deposition is already widely used in industry. For example, the turbine blades in jet engines are coated with a thin layer of heat-resistant ceramic; this keeps them from melting in the high operating temperatures inside the engine.

Etching, another valuable plasma technique, is widely used in the semiconductor industry to carve tiny shapes in the surface of a chip or remove thin layers of material. Plasma particles bombard the surface of the material to be removed; the particles bond with the surface molecules to form a gas which then drifts away, taking with it a layer of material.

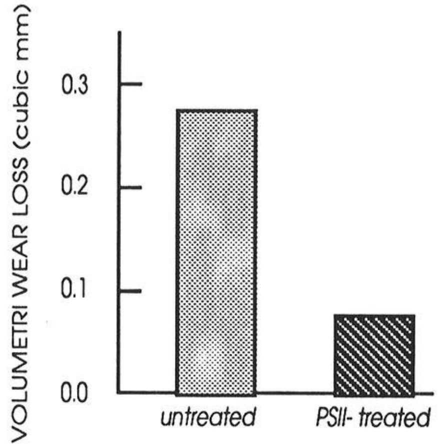
Semiconductor manufacturers also use plasma to modify materials. During one step in the formation of transistors, a beam of oxygen ions bombards a crystal of silicon; the ions come to rest below the surface, forming an insulating layer of silicon dioxide. The Ford Motor Company uses a material-modifying technique called sputtering. A plasma is made of argon gas; the argon ions strike a silver target and "sputter" silver atoms into the



Industrial cutting tool mounted on target stage of Professor Conrad's Plasma Source Ion Implantation device, in preparation for the surface modification treatment



Cross section of the cutting edge of an industrial punch after 20,000 operations



Volumetric wear for an industrial punch after 20,000 operations

windshield, forming a thin layer just under the surface of the glass. When an electric current is passed through this layer, the windshield heats up to melt off ice and snow during the winter.

Right here on the Madison campus, John Conrad, a professor of nuclear engineering and engineering physics, has developed a technique called Plasma Source Ion Implantation (PSII). This technique improves the performance and lengthens the life of surgical equipment and tools used in industry, without significantly increasing the cost. For example, after this simple and inexpensive treatment, factory tools for punching holes in steel plates can last as much as 80 times longer than untreated punches.

Ion implantation affects tools in three ways. A chemical reaction during the implantation process makes a tool harder. For example, when nitrogen ions are implanted into a chromium tool, the two elements form a very strong chemical bond, resulting in a much tougher material.

Ion implantation can also make a tool more fracture-resistant. With frequent use, microscopic cracks in the surface of a tool become larger and larger and, eventually, pieces of material split off. When ions are implanted, the material swells and the cracks close, reducing the risk of fractures.

The force of the ions hitting the surface of the tool sometimes acts like microscopic sandpaper, rubbing off tiny projections and smoothing the surface. This reduces friction when the tool is used; it runs cooler and lasts longer.

Ion implantation is nothing new to industry; manufactures already use it to improve tools. What is new is the amount of money that Conrad's process saves them. Before his process was developed, an ion beam was aimed from the source of the ions at the object to be treated. This worked fine for implanting ions in flat objects. However, treating an irregularly-shaped object like a drill bit required complicated manipulation of the bit to ensure that the ions reached the entire surface; the sophisticated, computer-controlled robot arms that can perform this level of delicate manipulation are horrendously expensive.

Conrad's idea is beautifully simple: he places the tool right inside the plasma source chamber. Ions penetrate the surface on all sides at once, and no manipulation is necessary.

Goals of the Center

With first-year funding of $1.5 million from the NSF, the College of Engineering, in cooperation with the University of Minnesota, will begin work in four initial project areas:

—plasma etching and microwave processing for microelectronics

—plasma deposition and polymerization

—plasma modification of material

—plasma synthesis, spraying and sintering

Many professors at both universities are already doing plasma research; the ERC will enable them to work as members of interdisciplinary teams and provide facilities and equipment which are needed to make major progress in transferring plasma technology to industry.

Plasma research will add a new dimension to the educational role of the College. The NSF expects all ERCs to develop advanced curricula and to offer special classes and seminars for graduates and undergraduates. The College now estimates that the ERC will involve more than 100 graduate students.

Another major mission of the ERC is to foster strong ties between the university and industry. The industrial consortium that was formed at the time of the first proposal has grown steadily; a meeting early in October was attended by representatives of more than 40 companies.

The consortium will play an active and vital role. Representatives from each industrial partner will remain in permanent contact with the ERC to help select research topics that the company feels will be most useful and profitable. Representatives will also advise the ERC of their needs for educational materials, and provide engineers and scientists from their companies to help in the ERC's research. In addition, companies will give staff and students from the ERC a chance to get some hands-on experience at their industrial sites.

The industrial partners' efforts and investment will continue to pay off for them for years. The ERC's research will undoubtedly lead to many new applications for plasma and refine many processes that industry is already using. Through time spent at the ERC, seminars, and other educational materials, companies can keep their employees up to date on the newest plasma techniques, and the graduate student program will provide a pool of highly qualified future employees. ▮▮

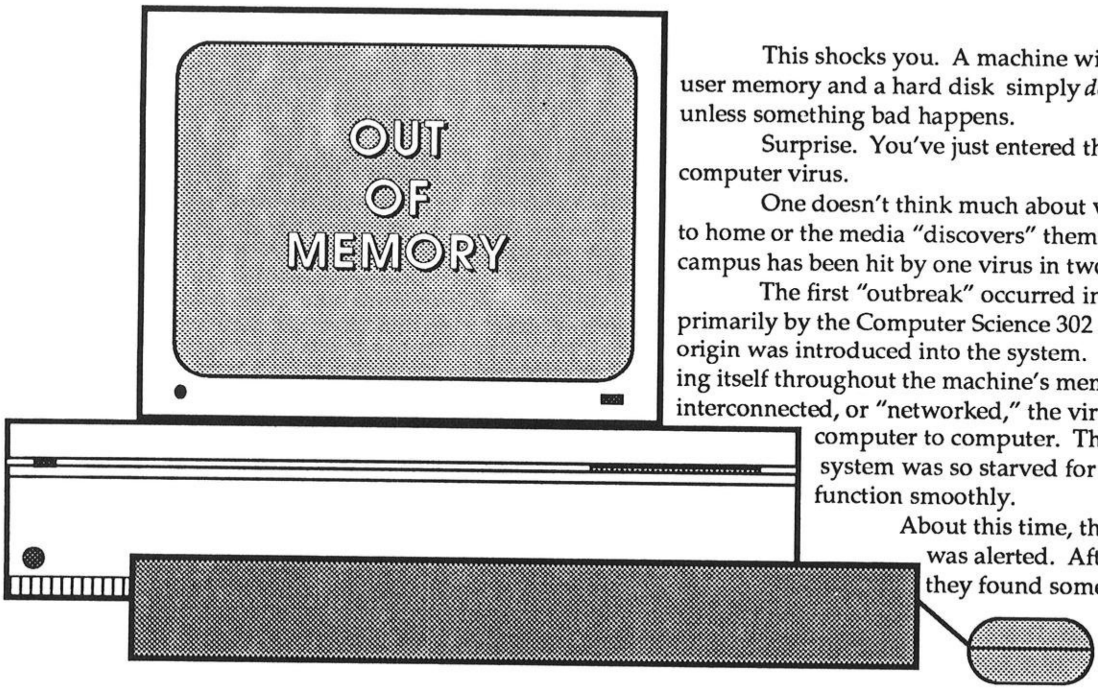
Graphics courtesy of Professor John Conrad.

UW-Madison 2
Computer Virus 0

The Labs Take On a New Opponent

- by Bob Apthorpe

Imagine yourself plugging away over in the Macintosh lab at Madison Academic Computing Center (MACC), mere minutes away from completing your Pascal program (due tomorrow morning, of course!) You take care of last-minute debugging and fine-tuning and click to compile.



This shocks you. A machine with a couple of megabytes of user memory and a hard disk simply *doesn't* run out of memory unless something bad happens.

Surprise. You've just entered the world of the computer virus.

One doesn't think much about viruses unless they hit close to home or the media "discovers" them. This semester the UW campus has been hit by one virus in two different labs.

The first "outbreak" occurred in the Macintosh lab used primarily by the Computer Science 302 classes. A virus of unknown origin was introduced into the system. There it quietly sat, replicating itself throughout the machine's memory. Since the Macs were interconnected, or "networked," the virus soon spread from computer to computer. This continued until the whole system was so starved for memory, it could no longer function smoothly.

About this time, the system maintenance staff was alerted. After several hours of analysis, they found something suspicious buried in a system folder. They had discovered the culprit: a virus masquerading as a system file called "nVir."

Once isolated and identified, the problem of decontamination remained. With such widespread contamination, only a brute-force technique could be used to restore the system to its original, uninfected state. Each machine had to be individually removed from the network so that its internal hard drive could be erased and reformatted. Virus-free system software had to be replaced on the machines along with the various compilers and utilities needed for the Computer Science 302 classes. Also installed was a utility analogous to a vaccine to prevent "nVir" from striking again.

The lab has recovered from the virus, but not without cost. The whole identification, purge, and inoculation process took about three days during which the whole Macintosh lab was shut down. However this doesn't take into account the time spent acquiring a 'vaccine' or the number of other programs wiped out during the purge. It is very fortunate that this virus infected the system during a period of low use instead of during the middle or end of the semester.

However, the dreaded "nVir" struck again, four weeks into the fall semester, at the Computer Aided Engineering (CAE) lab. CAE consultants estimate that up to 85% of the 70 Macintosh computers were infected at the virus' peak. During this time up to 400 students used the lab. After the vaccine "KillVirus" was installed, only 5% of the computers remained ill. Now, consultants check for the virus on a regular basis. Unlike the machines at MACC, the computers at CAE are not yet networked. When the network is installed, the system will be checked for viruses every day.

Viruses let us see computers in a different light. Instead of just an often-ornery box of electronics that processes our words, plots our graphs, and crunches our numbers, we begin to see the subtle web of computer influence around us. An important point to remember is that the Macintoshes that became infected were networked. A network is only one of four major ways a virus can get into a computer system. In order to defend against viruses one must look at the possible routes of infection. The key is data transfer.

First, viruses can get into a system via floppy disk. Floppy disks are still the most common method of non-volatile (long-term) data storage in personal computers due to their widespread availability and their low cost. Unlike most hard disks, floppy disks are portable and dirt cheap. Inadvertently using an infected floppy disk is a simple way to introduce a virus into a computer. A recent *Time Magazine* article traced a particular virus from the U.S. back to, of all places, Pakistan. Two brothers had created a virus with the intent of punishing American software pirates. The potential of spreading viruses via illicitly-copied software may put a damper on piracy, much like herpes heralded the

A Quick and Dirty Guide to Viruses:

A "virus" is a small program that has some very unusual properties. It may be able to relocate or copy itself in memory or on disks. Additionally, it is usually invisible to the host computer. More sophisticated viruses have a delayed effect. They can lie dormant for long periods of time, awaiting some sort of signal, such as a certain date, a specific user log-on, or modem activity. Some viruses have been rumored to be able to determine if the host machine has a modem with call out capabilities and if so, the virus could start making many long-distance phone calls. With the ability to tell time, this virus could conceivably make all these phone calls from midnight to 5 AM, when it would be least likely to be detected.

With increased sophistication, the virus becomes larger and larger which makes it more difficult to conceal. In order to escape detection on a particular system, the virus's creator has to know a lot about the way that system works. If someone was that good of a programmer, it seems kind of odd that they would waste their time on making viruses when they probably could be making money instead.

Cleaning up after a virus is a pain. Data, for the most part, cannot be recovered. To remove a virus from volatile memory, the simple solution is to turn off the machine. When a virus embeds itself in non-volatile memory, one must individually clear out each section of memory. The term "volatile" in regard to memory refers to the fact that the contents of memory are lost when the power is turned off. Disks are considered to be storage, not memory, but functionally they act as a form of non-volatile memory and need to be erased and reformatted. Even with this purge of memory and storage devices, viruses can linger on. There are always tiny, forgotten spaces on disks, buffers and the like, where a virus might be hiding out.

Noting the sheer number of immunological references, one would think that actual viral behavior could be modeled on a computer. Biological elements would be simulated by tiny programs, one infecting another and in turn be hunted down by others. An interesting application of something once considered just a game.

end of the casual sex era, certainly the same "hygienic" rules apply to sex and software: be safe or be sorry.

The next two methods of virus transmission are technically similar but different in scope: networks and modems. Computer networks tend to be very susceptible because of the ease in communication between infected and non-infected machines. Networks were primarily designed to allow easy communication between machines and that is precisely what makes them so vulnerable. By allowing unimpeded data transfer, networks act as a sort of circulatory system, blindly shuttling logic pulses back and forth, oblivious to the effect those pulses may have on the computers they connect.

A networked system is relatively safe if it is kept isolated from the rest of the potentially infected world. This is where the modem fits into the picture. Modem stands for <u>mo</u>dulator/<u>dem</u>odulator, a device that allows computers to transmit and receive data over ordinary telephone lines or, in some cases, through satellite uplinks. At this point viruses could become truly dangerous. It is possible to link university computers into statewide and nationwide computer networks such as Arpanet, Bitnet, and others. This gives a virus a comparatively immense universe to operate in. Imagine the effect of a virus on bank operations, stock and futures trading, air-traffic control, hospital operations, telephone switching, electric power management, *ad infinitum*. The effect is breathtaking and certainly a nightmare not too short of a nuclear exchange.

This apocalyptic scenario is extremely unlikely, however. Viruses are machine-specific; that is, a virus that infects a specific model of computer will not work on another machine. In recent years, manufacturers have been making their machines more and more compatible, as the proliferation of IBM-PC clones vividly demonstrates. Like networking, cloning has its advantages and disadvantages.

There is one method of virus transmission remaining which explains both how viruses come into existence and why the electronic Armageddon hasn't happened yet. The key question is: where do computer viruses come from? Like the biological variety, computer viruses don't mystically appear. Machines, as much as some may wish, are not too creative. It takes a human mind to devise and produce a computer virus.

Why do people make them? Principal speculation is divided between curiosity and revenge. One of the earliest and most fascinating computer creations is a game called Life. Developed in the 1960s, Life simulates in a computer's memory small colonies of cells that seem to grow and recede with the passage of time. Most colonies die off rapidly but some configurations of "cells" are stable; some even "move" or produce a form of digital "offspring." With a little effort, a curious programmer could create a form of "life," albeit an unintelligent and destructive one.

In fact, a type of bacteriological warfare has been going on for several years between programmers as a form of recreation. Called "Core Wars" (in reference to an archaic form of computer memory consisting of tiny ferrite rings or 'cores'), programmers around the country create tiny viruses and set them loose on each other in an arena consisting of a section of memory. The object is simple: whoever's virus survives, wins.

It is not these viruses that have been strangling computers, however. Core Wars viruses are written in a specialized language that was developed specifically to standardize the competition. Rather, the most common viruses are those developed by disgruntled employees and the more mean-spirited of the usually placid and misunderstood computer set. The effect of the computer virus on the public's view of "hackers" may be similar to the effect the atom bomb had on the reputation of science in general and nuclear physics in particular.

Some blame this irresponsibility on the explosive development of the computer industry. They claim that technology has advanced so rapidly that professional ethics have been left far behind. Sociologists will argue endlessly over it; the real reason will probably never be known. Though, like most fads, the current popularity of viruses will most likely fade.

Regardless of intent, the effect of computer viruses is still being felt here. We can only hope that like any other illness, the computer virus will run its course. Let us hope it is a painless one.

The Corvette They Call the
King of the Hill

- *by Peter Holmi*

Imagine this. You finally get the chance to position yourself behind the steering wheel of the 1989 ZR1, the "King of the Hill" Corvette. The engineering that went into the $50,000 plus super car has transformed a "Plain Jane" four wheel transportation device into a finely tuned machine capable of nearly 200 mph and 0 to 60 mph acceleration times in the very low four second region. The old phrase, "You can tell the men from the boys by the price of their toys", runs through your head. Your next thought is, "I envy the men who can afford a toy like this." With the new engine, transmission and other goodies, the wonderful people at General Motor's Chevrolet Motor Division have created a toy that is only exceeded by a very small group of six-figure-plus priced exotic cars from Europe.

The 1989 ZR1 Corvette has the all new LT5 engine. The only similarities between the LT5 and the standard engine are the 350 cu. in. displacement and the 90° V-8 engine configuration. The LT5 engine has four valves per cylinder and four chain driven overhead cams. At 385 horsepower and 370 foot pounds of torque, the engine pulls the Corvette from 0 to 100 mph in just over ten seconds. This engine also gets 1.5 miles per gallon better than the standard moderate performance engine while maintaining the EPA vehicle emission standards.

The ZR1 option also includes the new ZF six speed manual transmission. The German built transmission features a unique computer-aided gear selection shift gate. Under normal driving conditions, gears two and three are "locked out" forcing the driver to shift from first to fourth. Of course, this feature is designed for maximum fuel economy. However, if the driver accelerates very quickly the transmission allows gears two and three to be used, optimizing the acceleration potential of the car. The computer control senses whether the engine is partially warmed up, the speed is between 10 and 19 mph, and the driver is using one third or less of the throttle's travel to determine if second and third gear should be "locked out". The sixth gear is used for maximum fuel efficiency while cruising. At 70 mph the engine is turning only 1600 rpm. The top speed of 180 mph actually occurs in fifth gear at approximately 6500 rpm.

The LT5 Engine

The LT5 engine was designed by GM's Lotus Engineering subsidiary and is manufactured by GM's Mercury Marine affiliate. The original design goals were 400 horsepower and 400 foot pounds of torque in a engine that would fit into the existing Corvette engine compartment.

Several different engine setups were explored. The possibilities of a supercharged or turbocharged V6 or V8 were considered. Instead, Lotus Engineering decided to go with a completely new engine design featuring four valves per cylinder and four chain-driven overhead camshafts.

The engine block is entirely new. Patterned from very heavy duty engines, the all aluminum block features extensive ribbing for increased strength and rigidity.

The all aluminum die cast block has specially forged aluminum cylinder sleeves manufactured by Mahle in Germany. The cylinder sleeves are coated with an extremely hard and durable nickel silicon substance used on some of the most expensive Ferraris , Porsches and Lotuses.

A special intake manifold was designed to feed the two intake valves. Airflow enters the intake manifold through a bank of three throttle plates. A tiny 22 mm throttle plate opens first at low engine output providing for good control of the engines first 30 horsepower. As the accelerator is further depressed, a pair of 59 mm throttle plates open to allow plenty of unrestricted air.

The air feeds an intake manifold runner for each intake valve, for a total of sixteen runners. Each runner is equipped with its own fuel injector with the second runner for each cylinder also having an additional throttle plate. The use of a single runner under normal operating conditions allows for smooth low-engine-rpm performance. When full power is demanded, the throttle plates for the second runners open and the engine shows maximum performance.

As with most of today's new cars, a sophisticated computer system controls the engine. The computer not only controls engine functions, but it also serves to protect the engine. For example, if the diagnostic system determines the oil temperature to be too low, the computer will not allow the second intake runners' throttle plate to open. This protection system can also be selected with a second ignition key. A dash mounted "valet" key can be used to limit engine performance by approximately 150 horsepower, the power obtained from the second runner throttle plates. For example, this feature could be used to prevent, or at least lessen the chance of young Mary getting into trouble while impressing her friends. The car still performs very well even with the engine power slightly limited.

Several other design considerations besides maximum horsepower were important to the LT5 engine. One major design obstacle was to get all the equipment into the existing Corvette engine bay. For example, normally the largest possible sprockets are used in overhead camshaft design to decrease some of the forces and noise but due to space restrictions, this strategy was not possible. The specified hydraulic lifters require a high minimum oil pressure necessitating a special lubrication system. Also, the engine had to be smooth and controllable at the low 650 rpm idle while capable of the very high performance at ten times that engine speed.

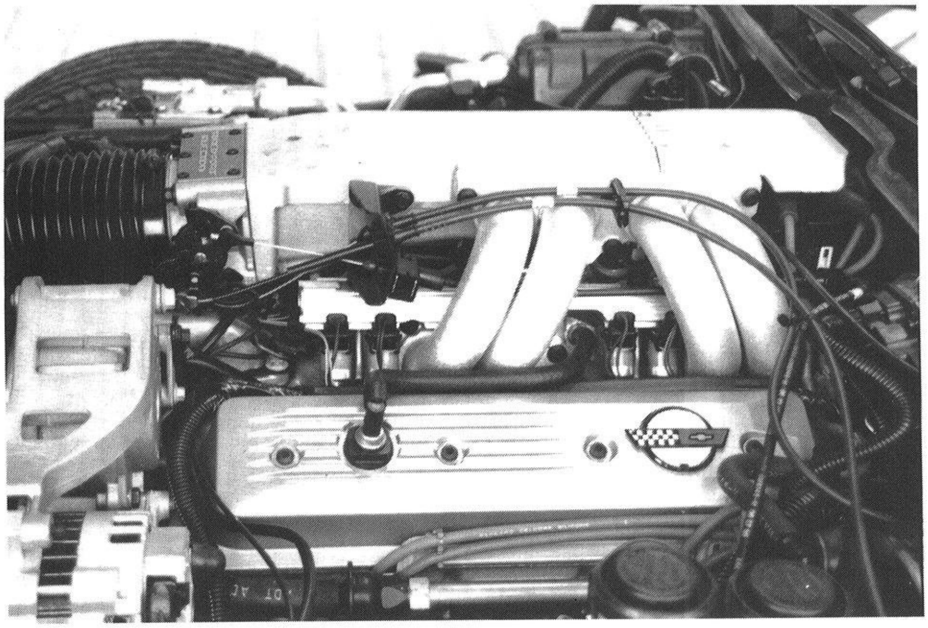
Other Features of the ZR1

Pure horsepower and torque allow a car to perform well, but if the power can not be transmitted to the road the power is useless. To provide for ample traction the ZR1 Corvette features miniature steamroller tires at all four corners. Larger tires, Goodyear P315/35ZR-17 Eagle ZR's, which are mounted on 11-inch rims, are located at the rear since the Corvette is rear wheel drive. "Big deal", you say until you picture setting two of the tires on a typical luxury sedan side by side. Looking at that quantitatively, the rear tires have a whopping 10.8 inches of contact patch on the road versus four to five inches for the typical tire. That is a lot of rubber on the road.

In front the Corvette is fitted with Goodyear Eagle ZR P275/40ZR-17 tires. The "Z" rating means the tire is designed for 150 mph cruising. Typical car tires are for use under 100 mph. The tires also help the car to pull 0.91 g's on GM's skid pad. To put that enormous figure into perspective, drive down the road someday and slam on the brakes. Take the force you felt as you were slowing and multiply that by two. Now imagine all that force exerted sideways as you go around a turn. All that cornering ability may make a ride on the ZR1 exciting compared to the next roller coaster you are on.

This car would be dangerous if it did not have good brakes. Therefore, the Corvette is naturally fitted with anti-lock brakes. Disc brakes with oversized rotors are standard at all four corners. The front brakes are thirteen inch dual caliper brakes. This braking system combined with the huge tires is designed to bring the car from the slightly under 200 mph top speed to zero in a very short distance without brake fade. Do not try this type of braking in the typical "grocery getter" car; the resulting damage may be expensive to fix.

As you might expect, the suspension also needs to be rugged to handle the forces a driver can generate in the ZR1 Corvette. The proven 1988 Corvette suspension is used with only slightly revised settings to reduce the camber change as the suspension moves. This adjustment helps keep the tires on the road, which is a comforting thought when you are cruising at 150 mph.



On the cosmetic side the ZR1 is not very different from the base Corvette. The fender flaring necessary for the huge rear tires begins at the center to back section of the door and gently flares. This flaring is almost invisible. The only obvious identification is the convex rear fascia which is visible from behind the car. Maybe the idea is that most cars will never see more than the back as the Corvette pulls away. Also, rumors of an analog instrument panel and air bags are floating around. We will not know until the first models are in the dealer showrooms early next year.

The ZR1 Corvette is quite an awesome piece of machinery. Of course, at a $50,000 plus price it ought to be. If you are thinking of picking one up, you better do so quickly, because the limited quantity of 2500 per year is not likely to last very long. Also, if you are waiting for a coupon or a rebate, you could be waiting an awful long time for a big disappointment. I don't think GM will be offering a coupon or a rebate on this car; this is unnecessary since one drive will probably do the trick. On a final note, next time you are out cruising around in your Porsche 944 thinking you are pretty hot stuff, don't try to race the sleek new Corvette from GM, you might be very disappointed and your friend might be very embarrassed with the results. ▮▮

A very special thanks to the Chevrolet Motor Division Customer Service Center, Tim Cahill at Foreign Car Specialists, and the people at Thorstadt Chevrolet.

Advice for Future Electrical Engineers

- from Michael Polakowski

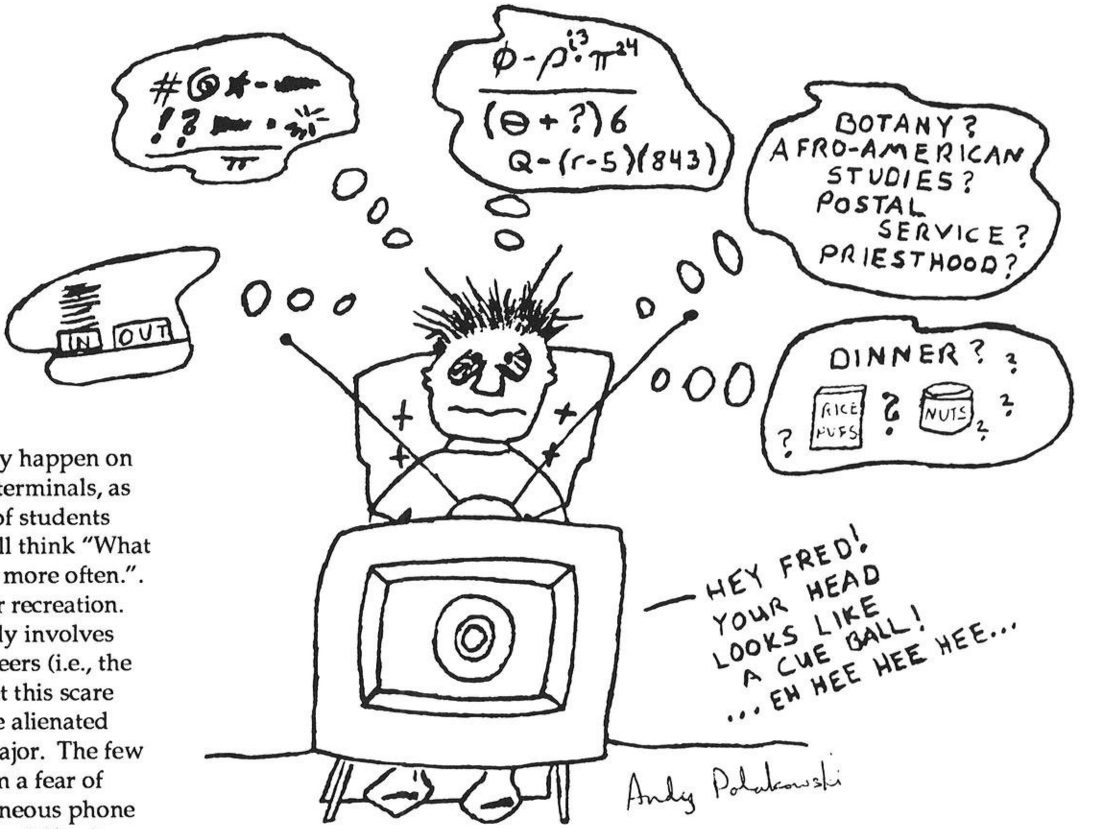
As we begin yet another semester here in Madison, I'll bet more than a few freshmen and sophomores are considering majoring in Electrical Engineering. Since this is my final undergraduate semester, and since I am also majoring in Electrical Engineering, I thought I'd pass along some words of advice to those about to choose this as their field.

Your first goal is admission into the department. There are a number of ways to achieve this goal, including transferring from another department, transferring from another school, and going on a hunger strike. Bribery and extortion may also turn the key (extortion, being the more cost-effective method, is preferred). Most students, however, opt to inflate their GPA via easy courses during the first few semesters. After all, becoming an electrical engineer means developing high ethical standards. If you don't get admitted on your first try, don't panic. Submit an appeal. Keep appealing until someone in the department realizes that you would be less of a nuisance if you were admitted. But watch those retro-credits; one day you'll be waiting for your appeal to be processed, the next day you'll have 88 credits and be on probation for not declaring a major.

Once you are in the department, there are a few things you should know. First of all, you will be majoring in Electrical and Computer Engineering. It's important to remember this since you will have to explain what "ECE" means to every recruiter you meet in years hence. You'll end up saying "double-E"; it's universally understood and requires less effort to articulate. Secondly, you will have quite a bit of freedom in arranging your course load. No advisor's signature is required to add, drop, or register for courses. In fact, if you know who your advisor is and nod at him once or twice in passing before you graduate, you've received more counseling than most of your classmates. Third, don't let the labyrinthine structure of the Engineering Building fool you. Each twist and turn has a specific function. Most new engineering students agree that the function is to completely disorient you, but soon they realize that the real function is to make the building look like a giant "EE" from the air. Once you are acquainted with the department, it's time to begin life as an electrical engineering student.

One semester you will not soon forget is your first one in the ECE Department. You will know it's your first semester when you find yourself scribbling a circuit into a notebook at 7:46 a.m. If you have a good memory, fast handwriting, and the ability to decipher greek letters scrawled on the blackboard at the rate of five per second, you should be able to keep within two problems of the professor for most of the period. Unless you have exceptional accuracy, however, your notes will be about 30% unintelligible, and the 70% that is readable will contain five or six errors. Take heart, though; this is the first part of the "character building" phase of the ECE curriculum. Professors tend to quiz the class frequently during this time. Common questions are: "Is anybody awake?", and "Are there any questions on the material nobody has had time to read?". Rhetorical statements like "I'm getting a lot of blank stares" set the mood for many informative discussions. If you're not used to asking questions of the professor, this is good time to start. A question directed toward the professor's area of interest (if you can ask it your first semester) is likely to set him off on a tangent for a good five minutes or so. This ploy may be used to defer discussion of a certain topic until the next lecture. It may also backfire, leaving you with three chapters of reading and homework to do the week before finals.

During your second semester in ECE (part two of the "character building" phase), a thought will occur to you. It may happen at 2:30 a.m. as you sit down to do your last homework problem. It may happen five hours later as you finish your breakfast of two aspirin and a cookie. It may happen on your way to the computer terminals, as you pass a carefree group of students playing hackey-sack. You'll think "What am I doing? I should relax more often.". And so begins the quest for recreation.



Recreation generally involves interaction with non-engineers (i.e., the rest of the world). Don't let this scare you; most of them won't be alienated when you mention your major. The few who are usually suffer from a fear of rational thought or an erroneous phone bill. Taking time off may be difficult or easy for you; either way, chances are good that you need it. You may wish to try something completely unrelated to engineering. Some electrical engineers have tried "channeling"; perhaps because the name has a certain electrical ring to it. They have rarely met with success, however, due to the fact that chanting "Om" merely conjured up images of resistors. As you try more activities, you will happen upon a few that you really enjoy. These generally take more time, cost more money, and endanger your health more than you can afford, but then so does school.

After your first year in ECE, things will not seem so bad. In fact, they will still be as bad, but you'll be used to them. You may not relish the thought of heading down to the computers late at night, but you know your friends will be there too, bogging down the system until dawn. As you take turns unclogging the printer or changing its shredded ribbon, you'll trade horror stories of professors and courses you have taken. After you have finished your assignment (or the computer crashes), you'll grab a couple of hours of sleep, quaff a soda for breakfast, and head for class. Back from school, you'll consider getting a head start on the next homework. Your mind, conditioned by the rigorous ECE curriculum, will insert this thought in your mental queue somewhere between "How can I get free HBO?" and "What will I eat for dinner next month?". With that dilemma settled, you'll most likely pop open a beer and watch the Flintstones.

Someday far, far in the future, you'll realize that soon you'll graduate. If you're feeling unusually brave at that moment, you may think about it for another three seconds or so, but most people immediately think about somthing more comforting, like death. Your final semester doesn't have to be the nightmare you think it will be, though. Some electrical engineers avoid the grueling days of job research and interviews by pursuing an advanced degree or buying large quantities of lottery tickets. Whatever path you choose, remember that there's no free lunch. Fortunately, this should not pose a problem, since you probably won't have time to eat it anyway. ▮

ENGINEERING BRIEFS

New Pre-Engineering Society

The College of Engineering has a new student organizaton, one specifically formed to promote the interests and needs of pre-engineering students. Jim Sensenbrenner, an EM3, is currently coordinationg efforts to organize the new group, which will be called P.R.E.S.S (the Pre-Engineering Student Society).

According to Jim, "Our goals are to help pre-engineers get involved in the engineering campus and find out about the resources that are available to them." Planned projects include the Big Sib program and a Day On Campus for high school seniors who are planning to enroll in the College of Engineering next fall.

Students who are interested in joining the organization can call Jim at 264-3655.

Career Night For Technical Writing

Are you interested in a high tech career that takes advantage of superior communication skills? The Technical Communications Certificate Program is sponsoring a presentation for such students. Rod Mell, a manager in the Information Development Department at IBM-Rochester, will give a 7:00 pm presentation titled "Careers in Technical Writing" November 10 at Union South (see Today in the Union for room location). Also on the program will be Elise Lind, ME4, who will speak on her recently completed technical communications internship at Nicolet Instruments Corporation.

wisconsin engineer

New Counselor For College of Engineering

The College of Engineering has a new part-time counselor. Linda Schilling, formerly a career counselor with Continuing Education Services, has been hired to help students wth personal, academic, or career-decision problems.

Ms. Schilling feels that she can help students with a wide range of problems. "Sometimes getting students to talk about a problem is a valuable first step. I feel I can help students with personal issues that may be affecting their academic performance. I can also help students with career decisions, such as choosing a major." Ms. Schilling replaces Jackye Thomas, who resigned to accept a student affairs position at MATC.

Students wishing to make an appointment can call 262-3507, or stop by Room 22 General Engineering.

EXPO '89
April 7,8,9, 1989

New Johnson Drive Computer Facility

Computer Aided Engineering has consolidated much of its resources from what were CAE East and CAE West into a new student computing center at 1410 Johnson Drive. The new building has both computer classrooms and open work areas with an impressive array of terminals, personal computers, and engineering workstations. The facilities are open 24 hours per day, seven days a week.

Mary Baldwin, one of the facility managers, emphasizes that the computing power was put in place with College of Engineering funds exclusively for engineering students. "This facility is not an open campus lab," according to Ms. Baldwin. "Any student who is taking an engineering course is welcome, but we aren't here to serve students from other schools and colleges."

Ms. Baldwin believes that students who are veterans of CAE are enjoying the sparkling new facilities and the greater number of computers. "The students are finding us and liking what they see. I've eliminated sign-up sheets, and I know the students are glad to see that. Now I can deal with students on a first-come, first-serve basis."

Consultants are available 8 am to midnight to help students with equipment and program problems. After midnight, student helpers are available to help with emergencies.

100° F and Rising:

How Serious is Global Warming?

- by Craig Fieschko

In the seventies and early eighties, a popular subject of conversation for the ecologically concerned was whether or not the earth was moving towards a new ice age. Scientists spoke of how the earth was in an interglacial period, and another ice age was due to arrive sometime in the near future. After a while, it was not uncommon to see the topic of a new ice age in the tabloid press (or even worse, in Sunday magazine supplements of major newspapers) with future projections of man living in ultramodern igloos, driving snowmobiles to work, taking the polar bear out for a walk, and other arctic dreams. The new hot topic, one that has received far more attention in 1988 than the ice age theory did over the entire last decade, is the theory that the earth is undergoing a major warming trend that could cause a global ecological catastrophe. The bad news is that it may not be a theory; it seems that it may very well be fact.

The name of this theory is the "greenhouse effect," and scientists are taking it seriously enough to establish a computer link between the United States and the Soviet Union for the sole purpose of exchanging dialogue and information on it. The United States government has even held Senate panel hearings and formed Congressional committees to study it. Some communities have even begun long-range planning to account for drastic changes in the climate; officials in Charleston, South Carolina have taken into account the rise in the ocean level that would occur with the melting of the polar icecaps in their design of a new storm sewer system. Still, despite all the talk and planning and media coverage, few people understand the greenhouse effect and its causes, and it has spawned a new bogeyman for people to worry over and scientists to argue about.

Some gases in the earth's atmosphere have a greater tendency to absorb and emit thermal radiation. Thermal radiation is "hot" radiation; it is what people feel when they step from a shadow into the sun on a warm day. Thermal radiation encompasses the visible spectrum as well as the infrared and part of the ultraviolet sections of the electromagnetic spectra. These gases, mainly polar molecules like carbon dioxide, water vapor, ammonia, and hydrocarbon gases, will absorb thermal radiation from the sun and then emit it, scattering the radiation through the atmosphere. This eventually reaches the

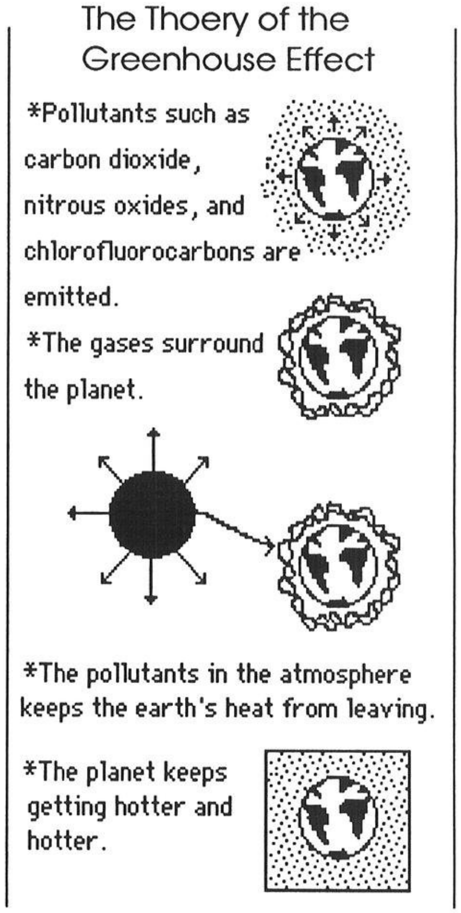
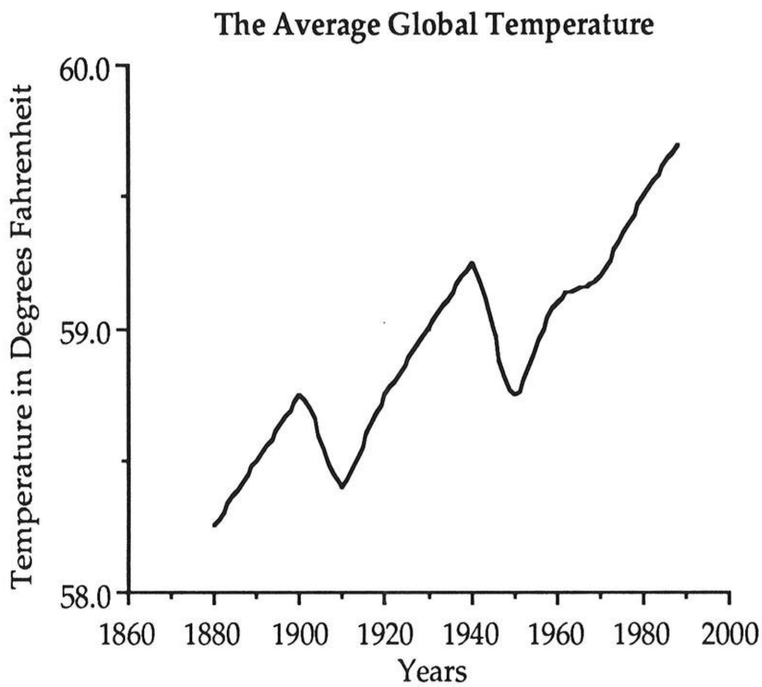


Figure 1

Figure 2



earth and has a warming effect. The greenhouse effect occurs because as these gases build up in the atmosphere, they work as an insulating shell around the planet because radiation has a harder time escaping the atmosphere. This is why it's called the greenhouse effect — the gases act in much the same manner as the glass in a greenhouse.

But why has the greenhouse effect suddenly made its presence known in the "great drought of '88" and in the heat wave felt in other areas of the world? Actually, it's been building up ever since the industrial revolution — global temperatures have been on the rise since the late 1800's. In the 1980's we have simply felt its presence more acutely than other decades have, with the three warmest years on record being 1987, 1983 and 1981 (and 1988 is not yet finished and therefore hasn't been added to the list yet.) The theory of the effect has been around for quite a while — it was used in the sixties to explain the extraordinarily high temperatures on the surface of Venus — but it has only been due to the erratic weather patterns of the past few years that it has captured such attention from the scientific community.

As James E. Hansen, a NASA expert on climatological changes, said in June after he testified before Congress: "It is time to stop waffling so much and say that the evidence is pretty strong that the greenhouse effect is here." But what can be done about it?

Unfortunately, not much. The problem lies in the fact that mankind's release of pollutants and waste gases that trap thermal radiation and feed the Effect, carbon dioxide chief among them, has been growing steadily since the industrial revolution. The burning of fossil fuels for power generation in power plants, industry, and everyday life has become a common part of life for the "civilized" nations, and any burning process releases carbon dioxide. As developing nations feel more and more of a push to industrialize in order to cope economically, more deforestation occurs to make room for cities and factories; according to a report by the World Resources Institute, this deforestation is occurring at the rate of 27 million acres per year. Once these plants are removed, they can no longer photosynthesize the carbon dioxide to oxygen. Many times the most efficient way for these countries to remove vegetation is by slashing and burning, but the burning of plants produces more carbon dioxide.

Even if vegetation is cut and left to rot, methane (another undesirable waste gas that has been tied to the effect) is produced. After deforestation occurs, cities and industries are built with power generated from fossil fuels, and once they are built they will need power to operate as well. It seems that if civilization continues to grow, it has very few options. The atmosphere has seen a rise in carbon dioxide from 280 to 340 parts per million over the last century alone due to increases in deforestation and the burning of fossil fuels, and as more and more forests are paved over to make room for people, this amount will rise even more.

How serious is the greenhouse effect, and what kind of impact will it have on our lives? Nobody really knows for sure yet, and scientists are working hard to try to forecast its effects. Some estimate a rise in the average global temperature of three to nine degrees over the next fifty years. These increases in tem-

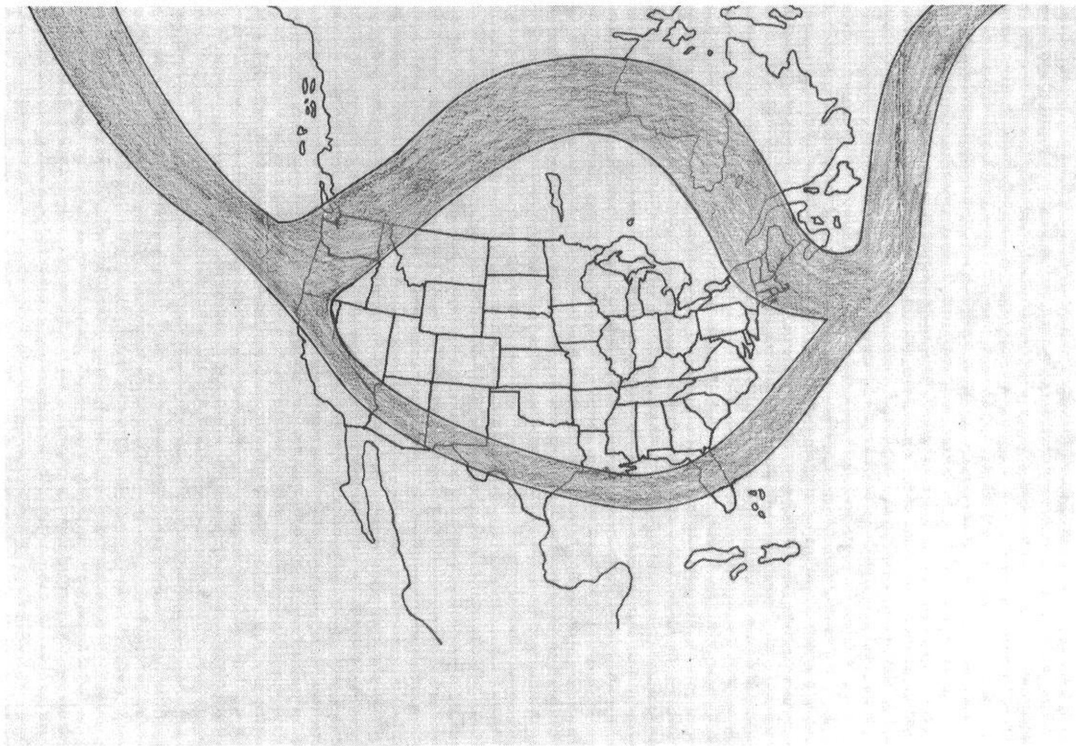


Figure 3

The jet stream split over the United States. Researchers blame this for the summer drought.

perature would be smaller near the equator but larger in the more northern and southern latitudes. It may not seem like much of an increase, but according to Dr. Irving R. Mintzer of the World Resources Institute, this would be the greatest increase in ten million years. Some scientists feel that it may rise even faster, and the only reason we haven't been feeling some really warm weather is due to increased volcanic activity emitting sun-blocking particles and the relatively low level of solar radiation. Others say that there is a lag time between the heat reaching the earth and warming the atmosphere due to the storage of thermal energy in the oceans. One thing that scientists do know for sure is that the jet stream over the United States split in two this year, moving over the southern states and Canada and leaving a huge high pressure zone over the midwest. This kept the rain away and resulted in the drought that everyone suffered and sweated over.

No definite evidence has been found tying this to the greenhouse effect, but it has a lot of scientists worried. Dr. Hansen of NASA warned the Senate that this scenario may become a common one over the midwest over the next decade. As anyone who has bought vegetables over the past few months can guess, this would certainly have an impact on the nation's food costs and availability. There is also a great deal of concern over the effects of the rise in ocean level due to melting polar icecaps and thermal expansion of the water. New Orleans would be underwater, but on the bright side, as Dr. Mintzer pointed out, the Arctic Ocean may be navigable all year long.

Although the forecasts sound terribly depressing, it must be remembered that so far there hasn't been enough research done to positively verify any of these projections. Some feel that since the earth is in an interglacial period, another ice age would offset the effect. Others feel that the hysteria is unjustified and the warm temperatures are just a side-effect of the 22-year solar cycle (and possibly also due to all the hot air the scientists are emitting arguing over the effect.) Perhaps in twenty years the Greenhouse Effect will be looked at as a peculiar form of scientific mass paranoia, a byproduct of the millenialism that comes with the closing of this century. But then again, maybe not. ▮▮▮

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* Figure 1: *New York Times*, June 26, 1988
Figure 2: *New York Times*, June 24, 1988
Figure 3: *New York Times*, June 18, 1988

College Life

the Aussie Way

- by Nick Denissen

Words to Know

grog - *booze*
Coke&Bundy - *rum and coke*
amber fluid or amber nectar - *beer*
tinny - *can of beer*
shielas - *women (no term for men. Sorry!)*
the local - *your local pub*
schooner - *a draught beer*
mate - *buddy*
fair dinkum - *"is that so?"*
POMME - *"Prisoner of Mother England" i.e. English people*
seppo - *an American*
meat pie - *national food*

Things to Do

- drink beer
- learn how to windsurf
- eat meat pies
- scuba dive
- pick out American tourists

Things to Pack

- flip flops
- boardshorts
- singlets (tank tops)
- stubby holder (to keep beer cold)

In September I moved to Madison from Sydney, Australia, where I had been studying and vacationing on and off for the last two years. It wasn't as hard to return to Madison life as I expected; even though Sydney and Madison are very different, the University of New South Wales and the UW have some similarities.

Sydney is the largest city in Australia. It has the "big city" atmosphere like London, New York, or Chicago - many types of people, different places to go and lots of things to do. It is located on the eastern coast of New South Wales and has approximately 3.7 million inhabitants. The weather ranges from the 30 °C in the summer to the 15 °C and in the winter.

Sydney is a beautiful city with a harbor many claim it is the world's most magnificent. It is one of the only major harbors in the world where one can still go swimming. Sydney has a lot to offer; the two most important features being pubs and beaches.

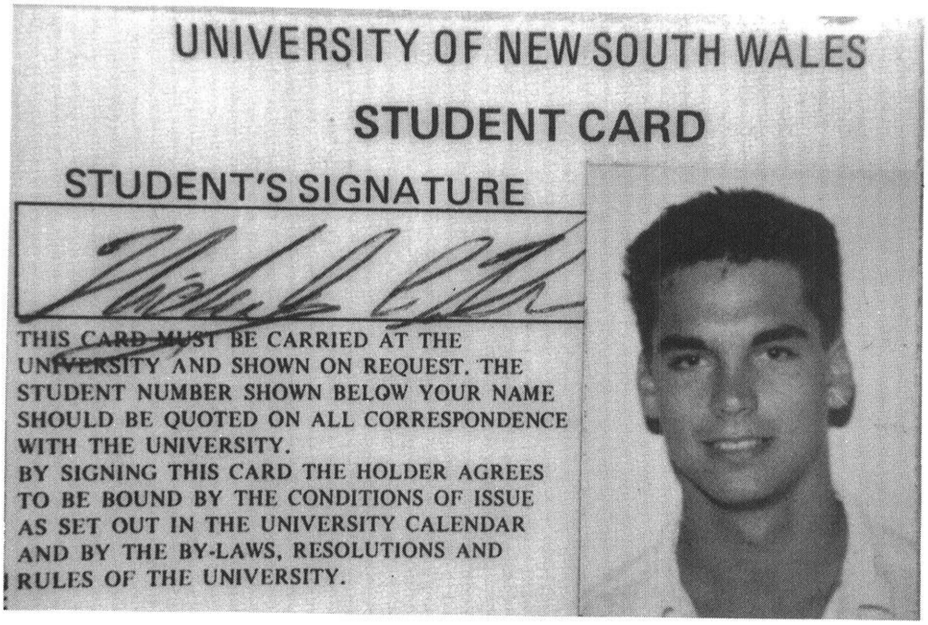
In addition, Sydney has some of the most beautiful residential areas of any major city. Places such as Double Bay, Hunters Hill, Seaforth, and Potts Point being premiere addresses. Many residences in these suburbs boast private beaches and moorings.

In Sydney there are three major universities: University of New South Wales, Sydney University, and Maquarie University. They are known as New South, Sydney Uni, and Maquarie, respectively. Each has their own character due to their own unique student body.

Sydney Uni, with its old buildings, ivy-covered gates, and snobby students, would compare to America's "Ivy League" schools. Maquarie would compare to smaller outlying colleges such as MATC or Edgewood College. As I found out New South is a breed of its own... (like the UW).

The University of New South Wales is located in Kensington, it is in a part of Sydney that resembles the usual student ghetto: rusted cars and unkept gardens. It is a 10-minute bus ride north to downtown and a 5-minute bus ride west to the beaches Coogee, Maroubra, and Bondi.

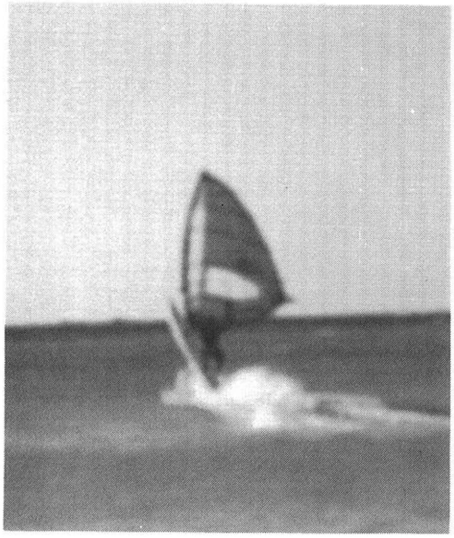
Unlike Madison, the campus is self-contained within the city; everything is in one spot and is surrounded by a



large fence. Sounds a bit like a POW camp, but it's not that bad. Actually, it's quite an attractive campus.

Parking, as in Madison, is a big problem. I remember many times when I drove to Uni, circled the "big fence" two or three times and couldn't find a parking spot. Not finding one would mean that fate had decided it was too nice to sit in a lecture, and that the time would be more wisely spent windsurfing. And if I did find a spot, it usually meant parallel parking into a spot that was three inches longer than the car. Then, after sitting in a lecture for an hour, I would run out to the car to wipe the chalk marks off the tire. (Yes, Sydney too has fascist parking enforcement.)

The student body is a little more radical and active than Madison's. A lot of students belong to the National Students Union. The union's main purpose is to get organized to protect themselves from "the establishment." The leaders are usually professional students. By this I mean the typical 30 to 40-year-old art major, who is working on his fourth degree and does not plan to graduate until he outlives his professors.



A classic example of an organized union activity occured in the beginning of last semester when students complained about tuition increases. Most thought the increase of 5% was too high (bringing tuition up to A$428.50, about US$340). So what do you do if you oppose the tuition increase? Bloody moan? Bullocks no! You just don't pay any of it. Teach the administration a lesson for being so bloody greedy! Of course, being well-mannered and conservative engineers as we were, we paid it. (Well, most of us did anyways.)

What is the administration going to do if 30% of the students don't pay tuition? Boot them all out? Never! They decided to try to pass a tuition plan in which all students pay tuition after graduation based on a percentage of their salary. When this came to the attention of the engineers who were fated to pay a higher percentage than other majors, the engineers also decided to join the protest. When I left, the government was still trying to think of other ways to finance education.

Another difference I have noticed between New South and the UW is how relaxed that students in Australia are. I believe the reason is that Sydney is not a "university town"; it's too large to be one. It's really rare to run into classmates while lazing on the beach or sipping a cold one at your local pub. Being a student there seems to be more like a job , a nine-to-five activity; here being a student is more a way of life.

Nonetheless, plenty of studying is done too. The typical student arrives by car or public transport (ferries, busses, and trains or subways) at around 8:00. After attending a few lectures and tutorials (and maybe even visiting the library), the average class day ends at 14:00. Lunch is usually spent sitting on the "library lawn" (New South's equivalent to Bascom Hill) eating a meat pie or attending one of the "social lunches" which are sponsored by one of the numerous student societies. These lunches are usually on every Wednesday, Thursday and Friday. They cost A$2 and you get all the snags (a mysterious-looking and tasting pork sausage) you can eat and all the beer you can drink. By beer I mean one of the following:

XXXX, Resches, Tooheys, VB, Coopers Ale, or Red Back. (Not Fosters. Blah!)

The class lectures, which are either an hour or an hour and a half long, are not very relaxed. On the first day of Quantum Physics, the professor said she had a list of all the students who had received Distinctions (very high grades) in the prerequisite course, and said she was going to ensure that they did not repeat that feat. If she heard someone talking during class, she would make them march to the front of the lecture hall (filled with about 100 students) to solve a problem on the overhead. It was quite an effective stunt; on the average, there was only one "talker" per week. In addition, she thought that tutorials (discussions) were a waste of time and substituted them with additional lectures.

After the first few weeks, the students start thinking about grades. Grading is very different in Australia. The scale is High Distinction, Distinction, Credit, Pass, Pass-Conceded, and Fail. There is no realistic way to map them into the A-F system. People try to get Credits and Passes there like A's and B's here. High Distinctions are reserved for Nobel Prize winners, and Distinctions for their assistants. The grades are usually determined by one mid-term or a major paper (about 30%) and the final exam (about 70%).

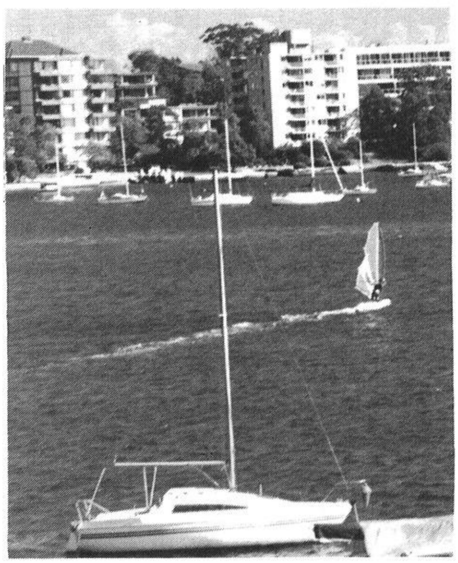
But all is not that grim! In the afternoon students either work or study a bit, and then they're off to have fun. This usually consists of windsurfing or sailboarding if the wind is up, or surfing when the swell is up. After about four days of this, everyone is usually ready for the weekend. Like in Madison, the weekend starts on Thursday and is usually spent partying and having fun.

There are always a lot of party boats (a party boat is something that is big, floats and can carry plenty of grog). They are mostly sponsored by student groups or societies and are open to everyone. Leaving the Opera House steps around 21:00, the boats cruise the harbor and return around 1:00 or 2:00. There is always plenty of grog, good music, and fun people. Not a bad deal for A$5.

Live music is another major way of enjoying the weekends in Sydney. Bands such as Crowded House, The Church, Big Pig, Mental As Anything, etc. ... play frequently. The gigs are usually at pubs; the atmosphere is great, the crowd is not too large, and most importantly there is always lots of cheap grog!

The weekend mornings usually start off with breakfast in Double Bay, skin cancer at the beach, and fun in the waves... The fun never ends!

If you haven't sussed it out yet, Australia is fun! There is something for everyone. Why not go and study there a semester. I don't know what tuition for foreigners is, but when you register, just tell them you're Aussie and you will only pay about US$350/semester (they hardly ever check). ▮▮▮



The cool shots of "the local" and some recreational windsurfing (obviously the rough life Nick mentions) were captured by Karin Denissen.

Engineering Mechanics Department Offers Astronautics Option

- by Barbara Angermann

A new undergraduate degree program designated as the Astronautics Option is offered this year by the Engineering Mechanics Department to improve and expand educational opportunities for engineering students in space-related areas. The option will appear on the students' degree as "Bachelor of Science in Engineering Mechanics - Astronautics Option."

Astronautics and aeronautics are both considered fields of aerospace engineering. Astronautics usually refers to spacecraft and rockets whereas aeronautics refers primarily to aircraft. Most programs around the country are extensions of former aeronautical engineering departments and are skewed toward aircraft design, aerodynamics and wind tunnel experimentation. The program at the University of Minnesota, which is available to Wisconsin students through the reciprocity agreement, is typical of this orientation.

The primary objective of the program at Wisconsin is to prepare students for a research and development career in the aerospace field, with an emphasis on applied mechanics and astronautics. It is a very challenging program that allows its graduates to either seek employment in the aerospace industry or continue with graduate education to improve their research potential.

The Astronautics Option was first proposed to the Engineering Mechanics Department the second semester of 86-87. Upon approval by the department it was proposed to and approved by the College of Engineering the first semester of 87-88. Then, it was presented to and approved by the UW-Madison Campus. It is currently under review by the UW System and should be approved soon.

The option was first proposed by Engineering Mechanics Professor Bud Schlack. "It bothered my conscience that we had so much going on in aerospace research and space-related work that students didn't know about and paid out-of-state tuition to get at other universities," commented Schlack.

Currently, there are no other undergraduate degree programs within the University of Wisconsin System which carry an aeronautics, aerospace or astronautics title as part of the degree designation. One purpose of the Astronautics Option in Engineering Mechanics is to make visible the large amount of research and instruction that is currently available here. "It is a program that we can do well in and make a niche for ourselves," says Schlack.

At this time, the Engineering Mechanics Department lists several examples of undergraduate programs for students with special interests in certain areas to follow. One of these programs is aerospace mechanics. This program includes some of classes that the Astronautics Option does, yet it will not lead to a formal designation on a student's degree. It is considered a less difficult program to follow.

The Astronautics Option requires a total of 135 credits for graduation, which is 3 more than the basic Engineering Mechanics degree. According to Schlack, the option is more difficult and may take students longer to complete.

The curriculum is also more rigid; the students are allowed less elective choice than if they followed one of the suggested special interest undergraduate programs.

Most of the courses needed to complete the degree are currently offered; and all will be offered by next year including a new satellite dynamics course.

The department has proposed new courses such as high speed aerodynamics, rocket dynamics and flight dynamics, and a spacecraft propulsion course to consider expanding into.

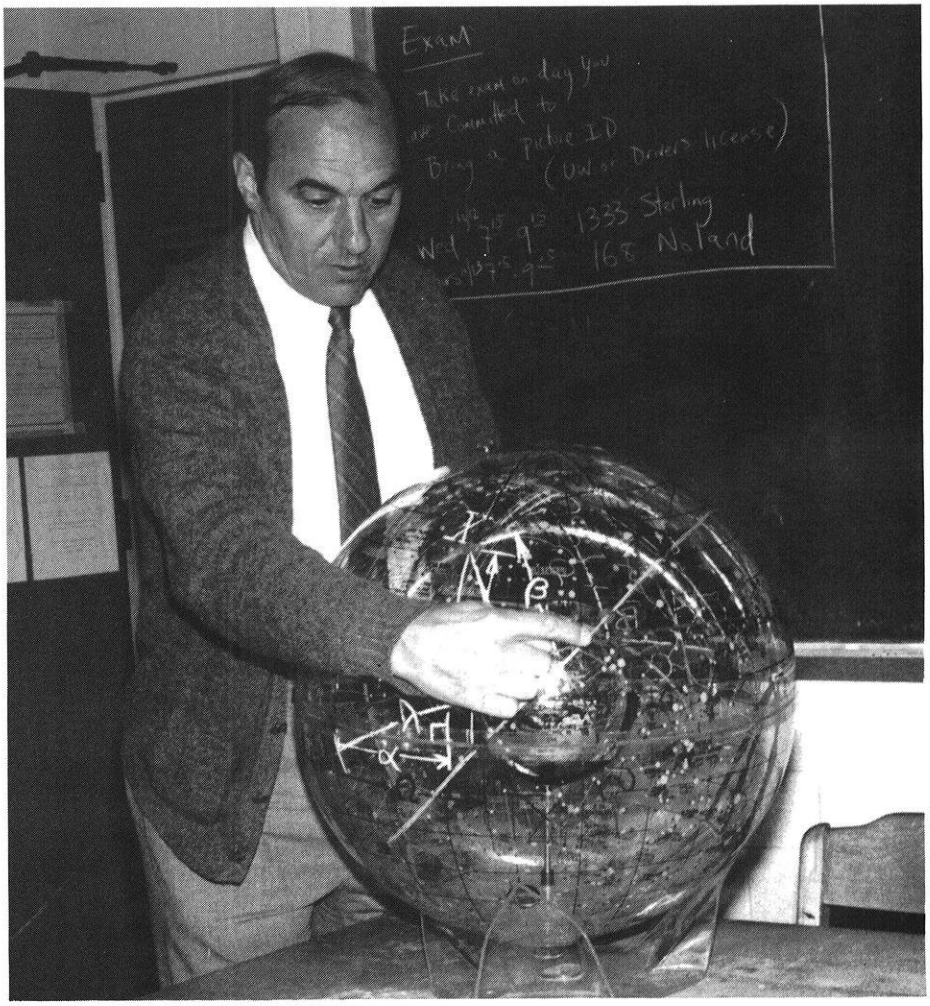
Additional faculty will be needed to teach and develop these courses in the future. The department originally predicted that at least two new faculty members in spacecraft dynamics and flight mechanics would need to be hired.

A new faculty member, Assistant Professor Dan Kammer, was hired this year by the department to possibly teach the Orbital Mechanics course and satellite dynamics in the next couple of years. Kammer has a background in spacecraft structural design and spacecraft dynamics. An aerodynamics and flight dynamics professor may also be hired this year.

Along with the new courses the department has proposed modifying existing course sections to include more spacecraft structural mechanics applications for astronautics students. Also, design courses would include aerospace design problems.

"Student interest in the option has been good," says Schlack. According to the Engineering Mechanics Department office, 20 students have shown interest in the option, but only four students have gone through the paperwork of signing up. Currently, there are about 200 undergraduate EM students.

Associate Dean George Maxwell attributes a 70% increase in interest in the Engineering Mechanics Department during Summer Orientation And Registration (SOAR) to the Astronautics Option.



Engineering Mechanics Professor Bud Schlack demonstrating the use of his celestial sphere for celestial mechanics classes

Space Age Materials Taking Off in Sporting Goods Industry

- *by Don Korjenek*

The sporting goods industry has gone high tech. This may come as no surprise to some, but others may be shocked to know that ceramics are not used strictly for the space shuttle. Being an engineer and a sports junkie I decided to look into the latest developments in the design and manufacture of tennis rackets, golf clubs, and other equipment which has undergone considerable change in recent years.

Certainly, the biggest area of recent advancement has been in the use of so— called "high-tech" material composites. The word composite has a specific and a general meaning. Specifically, composites refer to fiber-reinforced materials that consist of high strength fibers embedded in or bonded to a matrix with distinct boundaries between them. The fibers are the principal load-carrying members, while the surrounding matrix keeps them in the desired location and orientation, acts as a load transfer medium, and protects them from environmental damage due to elevated temperatures or humidity.

The principal fibers in use are glass, carbon, boron, Kevlar, and silicon carbide. The matrix material may be a polymer, metal, or a ceramic. The general meaning of composites in the sports industry refers to different composite layers stacked one of top of each other and bonded together.

My first good tennis racket was a Jack Kramer Prostaff, made of 100% wood. This was a top-of-the line model, the summit of racket engineering. Today, wood rackets are relics in the tennis hall of fame. In fact, until 1967 wood was the exclusive performance racket material. Then, with the introduction of steel and aluminum rackets, came the first push to enhance performance by improving the equipment materials. Although wood was easy on the player's

Figure 1

MATERIAL	Strength	Stiffness	Abrasion Resistance	Vibration Damping	Cost per Pound
Graphite	1	2	9	6	$22.00
Boron	2	1	10	7	280.00
Kevlar	3	4	7	3	35.00
Twaron	4	5	8	4	42.00
Ceramic	5	3	5	5	68.00
Fiberglass	6	10	6	2	5.00
Titanium	7	8	1	9	100.00
Steel	8	7	1	11	2.50
Aluminum	9	6	1	10	4.00
Magnesium	10	9	1	8	9.00
Wood	11	11	11	1	.10

* This chart shows how common raquet materials compare. A ranking of 1 is best, 11 the worst.

arm because of excellent vibration damping, steel and aluminum offered better strength and stiffness.

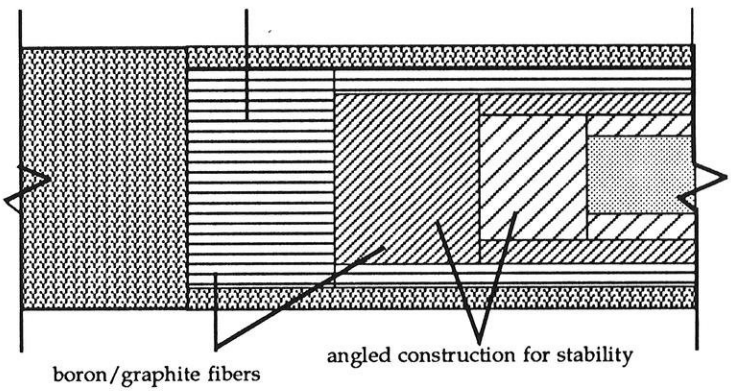
Fiberglass emerged as the next significant new material. Fiberglass has a better strength-to-weight ratio than aluminum or steel, and thus is more versatile. It was in the early seventies that the first composite frames using fiberglass and aluminum were introduced.

The first quantum leap in racket construction came in the mid-1970's, when graphite became the material of choice in tennis rackets. One look at figure 1 shows why. Graphite is strong, stiff, light, and still able to damp vibrations. Graphite led the way for the use of today's materials, and it remains the most common racket material.

Other materials which have found their way into racket design are Boron, Kevlar (found in bullet-proof vests), Twaron, and Ceramic. Of these, ceramic has shown to be the most popular. Ceramic or Silicon Carbide fibers are similar to graphite with less strength and slightly better vibration damping. Many of the white colored rackets seen today use ceramic fibers in their construction.

While all of the materials listed in figure 1 have their merits and faults, it is the combining of these materials that allows design engineers to create the best performing rackets. Although graphite rackets were originally a single composite; today nearly all rackets are multi-layered composites. The percentages of these high-tech material layers, and where and how they are used are the major factors in a racket's playability. In this way composites give the engineer total freedom of design.

Figure 2



* Section view of Yamaha's golf club shaft

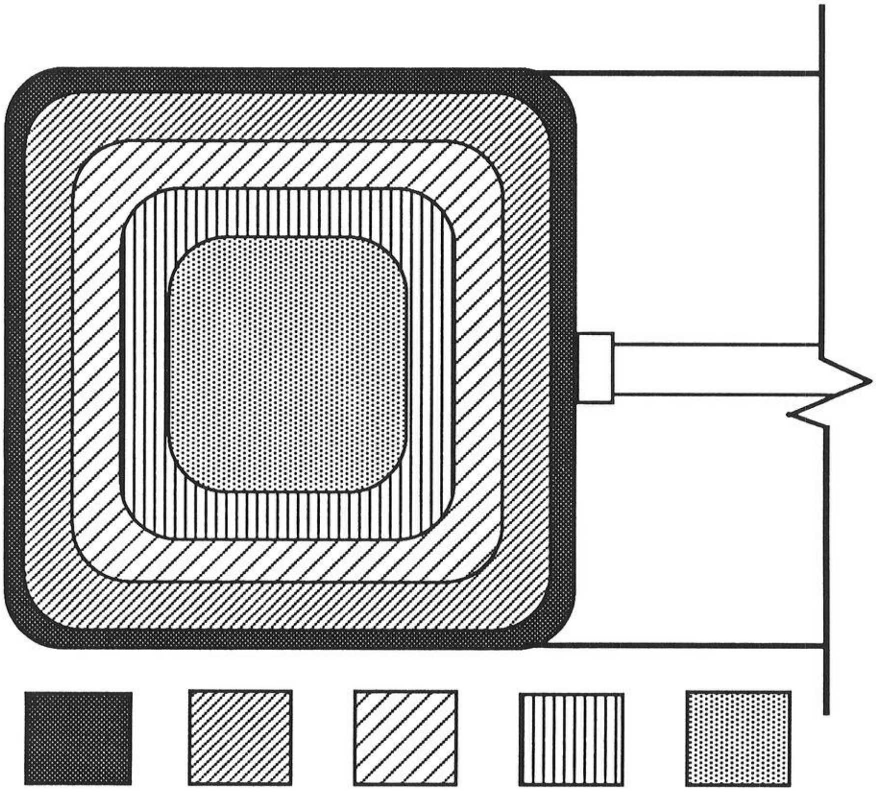
The golf club industry has also undergone dramatic changes recently by using aerospace technology in club design. In a golf club the shaft is the most important element, because it transfers energy from the body to the clubhead. It is in the shaft that most of the latest improvements have been made.

While graphite tennis rackets were accepted almost immediately, graphite golf shafts had a disappointing debut in the mid 1970's. First, the tensile strength of the graphite matrix was so low that torsion of the shaft became a problem. Second, the light graphite shafts caused club designers to add clubhead weight to maintain traditional swing weights. This only increased the instability of the shaft. Today however graphite or boron/graphite shafts have made a comeback due to design improvements (see figure 2).

Similarly, the clubhead of a golf club has come a long way since a '3-wood' was always made of real wood. Today, steel, graphite, and even ceramics are being used. These new-generation clubheads are light, strong, and extremely durable. Their only fault it seems is that they defy tradition. Still, many golfers today are using these new clubs with great success.

The manufacturing of graphite composite tennis rackets and golf club shafts is expensive. Graphite, a soft black carbon that is created when polycrylontrile fiber is heated to 5000 F in an inert atmosphere, is usually combined

Figure 3



* The cross section of the frame of a tennis racket head.

with an epoxy resin to form a composite. The graphite is manufactured into a parallel thread like form. These graphite filaments, can be strengthened through various heating processes. Then, graphite filament mats are layered at angles to produce specific mechanical properties. After that they are rolled and placed into a mold. Here the use of high temperatures and either an expandable foam core or high pressure result in the final product. The fibers can also be braided, which results in different but not necessarily better properties. The major expense of this system lies in the molds. They are costly to design, manufacture, and replace when worn.

Both boron and ceramics are processed in similar ways, and are used in the overall composite frame or shaft. As figure 2 and figure 3 show, layering of different materials can produce a final product with the benefits of all the materials chosen.

The use of high-tech materials in sporting goods is not limited to the tennis and golf industries. Skis, for example, use much of the same technology. It would seem the possibilities are endless in many other sports, but regulations do exist. The United States Golf Association, for example, limits the distance a ball can fly under given test conditions. Also, Major League Baseball doesn't allow metal bats or cork (hardly a high-tech material) in the wood bats.

Despite regulations, Americans, in our quest to be the best we can be, are demanding more from our sporting goods equipment. The use of high-tech materials has certainly answered that call for now. Personally, I won't be satisfied until my shoes allow me to dunk a basketball, or my tennis racket serves an ace every time. Okay, I'll settle for Rodney Dangerfield's putter from the movie "Caddyshack".

* Figure 1: *Tennis Magazine*, August 1988
Figure 2: *Popular Mechanics*, June 1988
Figure 3: *Tennis Magazine*, December 1986

Letters From Japan

We, at the International Engineering Programs Office, have received letters from three scholars in the College's UW-Japan Engineering Leadership Program, currently in academic work at Hokkaido and Osaka Universities in Japan. We would like to share with the *Wisconsin Engineer* readers some Japanese experiences and photos that they have shared with us:

September 8, 1988

"...Hokkaido University, commonly called Hokudai, is one of seven nationally sponsored universities. For undergrads, university life is relatively easy. After years of grueling preparation for the trying entrance exams, students find themselves with extra time. Lectures are comparatively few, as students are expected to learn more on their own. Much of this spare time is devoted to numerous club activities. However, students must devote some time in their senior year to writing a graduation thesis. Currently we are also writing such papers.

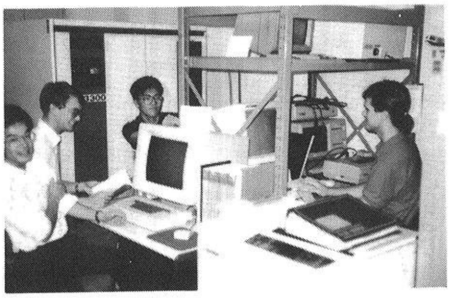
Graduate student life is also quite different. Graduates are organized into study groups beneath a professor. Each study group holds a weekly seminar at which the students present their research to the group and the professor. As special students, we are also in such study groups and therefore must present our research in the same way.

These study groups take the opportunity to relax every once in a while, too. In addition to picnicking, hiking, and socializing. Japan offers some unique recreational activities not found in the United States. One of the varieties of bars popular with the study groups is called an "izakaya." Izakauas stress tasty foods, good drinks, and conversation as the customers are seated around short tables in separate groups.

Another type of popular drinking establishment is the "karaoke" bar. A karaoke is a sing-along jukebox where customers pay to sing to the accompaniment of popular tunes with the vocals removed. And, of course, there are the famous Japanese baths, the most popular of which are natural hot springs. We have participated in all of these activities.

Japan is still a unique opportunity for foreign students. Despite recent efforts to "internationalize" the country, exchange students are still few and far between. The Ministry of Education is trying very hard to attract students from overseas. This means special fringe benefits including tours and financial assistance are available. It takes some of the worry out of studying abroad. We recommend all interested students to pursue this opportunity further. It is an unforgettable experience."

Kirk Freeman
ECE-4

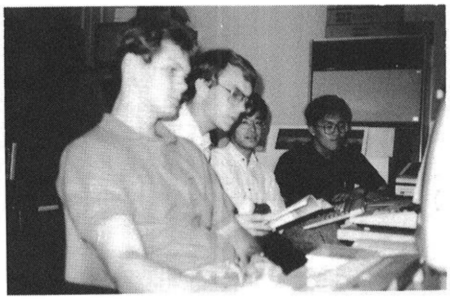


Gregory Lillegard (second from l.) and Kirk Freeman (far r.)

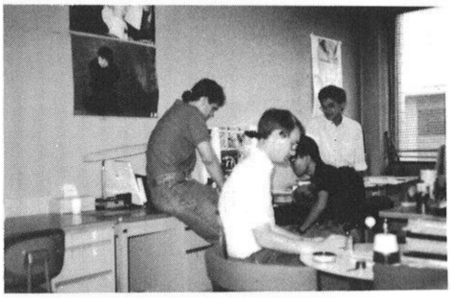
March 10, 1988

"...Next week I have two plant trips within the Fuji-Xerox organization in order to become more familiar with the company and to introduce me to people who might have a training position for me in October. At this point, a training position for the end of the year is looking very promising..."

Andrew Strauch
ECE-4



Kirk Freeman (far L.) and Gregory Lillegard (second from L.)



Kirk Freeman (far L.) and Gregory Lillegard (second from L.)

September 6, 1988

"...So far I have been here seven months at Fuji-Xerox in Tokyo and Osaka University, and they have been some of the most interesting of my life. Coming over here has given me the opportunity to experience a totally different culture first-hand. I came over here with a lot of misconceptions about the Japanese and the United States. This year abroad is giving me a chance to put things in perspective and is consequently helping me to decide my goals for the future.

Going abroad costs in many different ways, mostly in time and money, but if you have the opportunity to make the time and earn the money, it's an experience not to be missed."

Andrew Strauch
ECE-4

The three scholars will take part in a training period with a Japanes firm to complete the "The Year in Japan" component of the UW-Japan Engineering Leadership Program sequence. Each student will return to UW-Madison in 1989 to complete degree requirements.

Further information on the program is available in the International Engineering Programs Office at 1402 University Avenue, Madison, WI 53706.
Phone: 608/263-4811

Education + Experience + Degree

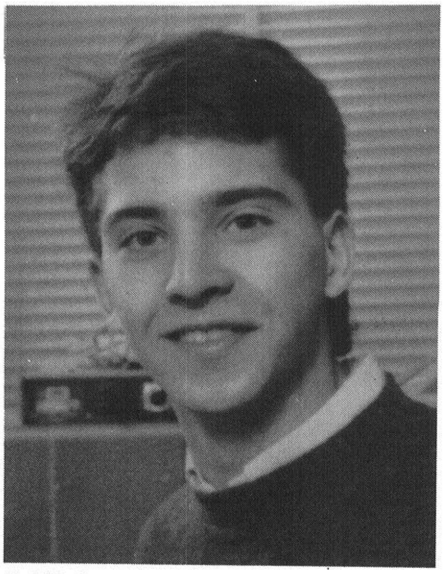
A Few Words About Co-op

"It was a cold, January, Saturday afternoon when my parents and I packed the car and headed off to Davenport, Iowa. Talk about nervous, I really didn't know what to expect. I was pretty lucky. ALCOA provided me with housing, which made the move a little easier to handle. After my parents left it hit me. I was alone! That Sunday night before my first day of work seemed to last forever. I must say that first day at work wasn't so bad. I met so many new people that I could barely remember their names."

"The first challenge I faced was just finding my way around the huge plant. The ALCOA plant at Davenport is over a mile long with 115 acres under one roof. ALCOA provides an orientation program for all new engineers. There were seven of us in the program, two co-ops and five new employees. The two week orientation gave us an opportunity to learn how the plant runs and also helped us to get acquainted with each other. Every day was spent in a different division of the plant, which gave us a chance to see where the other new employees worked and what they did."

"After the completion of my first work package, I was given a punch list of items to work on. An example of one such project was where the operators needed to position a conveyor more accurately because it wasn't lining up correctly. An electrical engineer introduced me to a Celesco encoder. The encoder's outputs were square quadrature, delayed 90 phase degrees, depending on whether the conveyor was moving toward or away from the encoder. The outputs were read by a General Electric high speed counter card that kept track of the position of the conveyor. This system was very accurate since the encoder outputs 100 counts per inch. This type of knowledge could not be picked up at school."

"No matter what project I was working on, there was some general knowledge that I needed to know. There was the incredible need for excellent communication skills. Whether writing a work package, requisitioning material, or just talking with other employees, I found it important that the other person know exactly what I was talking about. I was told that if I didn't explain exactly



Joel Kaphengst

what needed to be done, it would not get done at all."

"I guess the most important thing I learned is that school and work go hand in hand. Before I can truly be considered an asset in the working world, I feel I need to learn more of the basics of electrical engineering. With my com-

= A Super Career Start

pleted college education, my ALCOA work experience will prove invaluable to me and my future employers. I believe that co-oping is one of the smartest things that a young engineer can do for themself. Not only did I learn skills that will help me in my engineering career, but I also made many lifetime friends. I missed Madison and school, but I also looked forward to my next co-op term."

The above report was written by Joel Kaphengst, an ECE student. Leo Janus, a mechanical engineering student, had this to say about his co-op job with the Kimberly-Clark Company:

"It is nice to step right into a company that is as highly respected in its field as Kimberly-Clark. My career plans have changed as a result of my work experience at Kimberly-Clark. My experience at Kimberly-Clark has allowed me to develop many skills that cannot be taught in a classroom setting."

Any engineering student in Madison has the opportunity to participate in such experiecnes. Opportunities are available in all engineering majors. They range from locations in Alaska to Florida, from California and New York to Wisconsin, and there are even opportunities abroad. Nick Denissen traveled all over Germany last fall working for McDonnell Douglas . Some of the jobs are 100% outdoors and could even involve traveling to work each morning in a helicopter.

The co-op office has scheduled the following interviews for fall, 1988:

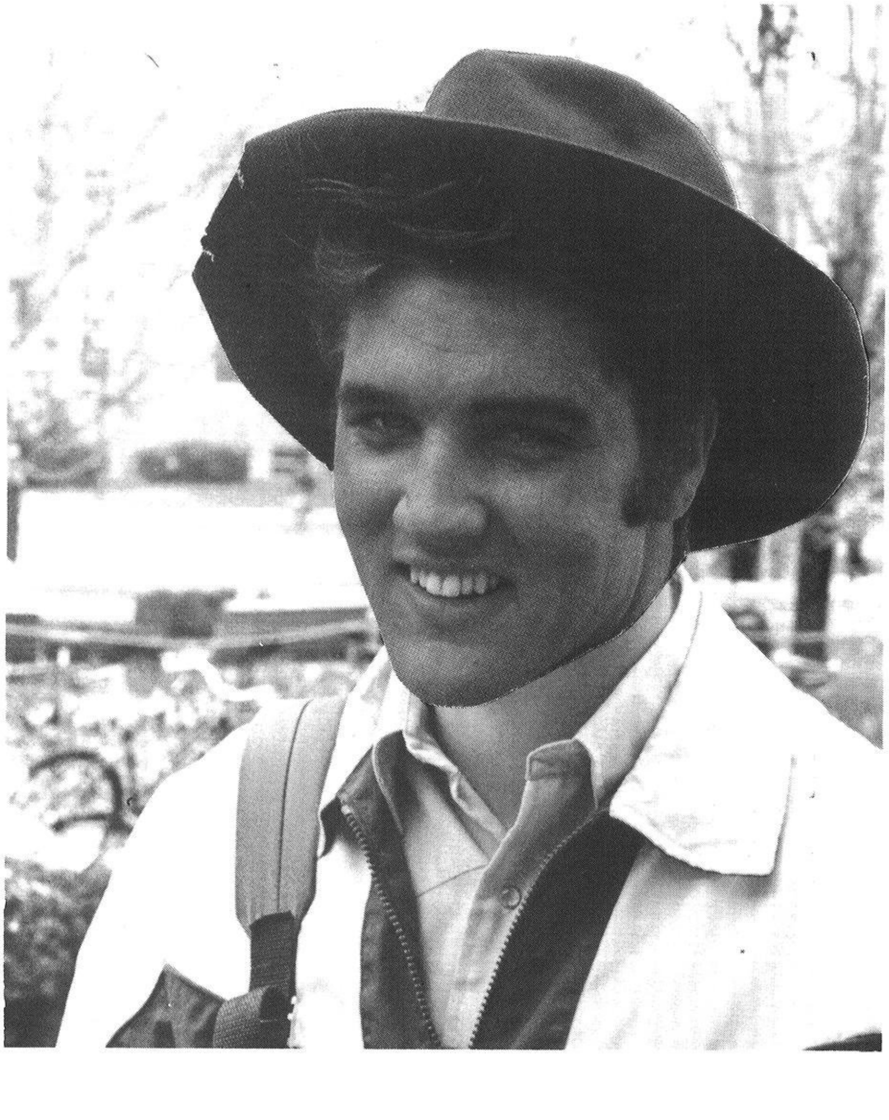
3M
Air Products
Apple
Amoco Foam
ALCOA
American National Can
B.P. America
Bureau of Land Management
Briggs and Stratton
Caterpillar
Control Data
Cummins
Dow
Exxon
General Mills
GM Buick
GM Saturn
GM Delco Electronics
GM Proving Grounds
Honeywell
Hutchinson Tech
Inland Steel
Illinois Dept. of Transportation
IBM- several locations
Johnson Controls
John Deere
James River
McDonnell Douglas

Co-op/Summer Sign-up Dates

Nov. 29, 1988	Co-op/Summer Sign-up Information at Union South, 4:30-5:30. Marion Beachely will talk about the advantages of co-op or summer internships in getting an interview or permanent placement upon graduation.
Dec. 12-16, 1988	Pick up application forms and directions in room 407 Wendt Library for summer and/or fall placement.
Jan. 17-27, 1989	Return completed application form and current transcript (with fall semester grades). Transcripts available in Peterson Building (campus copy is acceptable).

Just One More

Elvis Presley Is Alive!



Elvis smiles for the *Just One More* photographer outside of the Engineering Building.

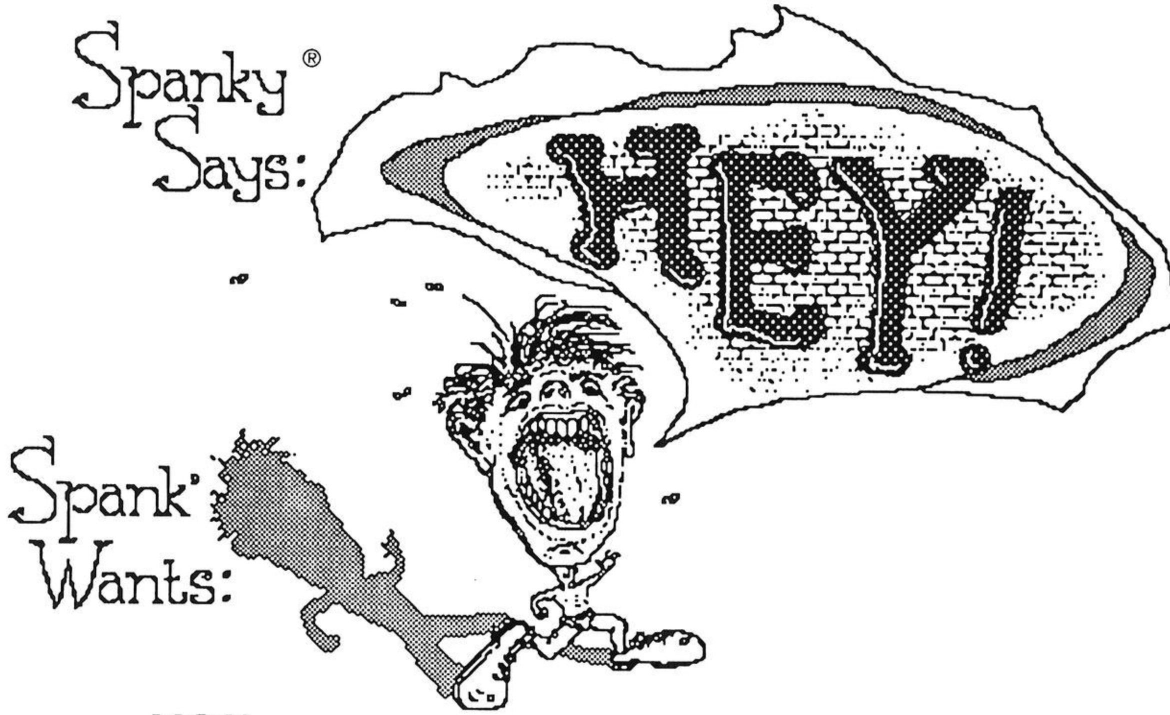
The King Seen on Engineering Campus

Madison, WI- Elvis Presley, fondly remembered as "The King," was spotted on the engineering campus last week.

Insiders say that Elvis, who reportedly died in 1977, is still alive and studying Statics with Professor Al-Abdulla at the University of Wisconsin-Madison. Students there have decided to keep Elvis' presence a secret, commenting that they respect his privacy, as well as his desire to be a Mechanical Engineer.

Elvis' family members and other close associates deny any existence of Elvis and claim that he is dead.

However, a *Just One More* source, who requests to remain anonymous, says that he spoke with The King. When asked about his disappearance from public life, The King remarked, "It was Priscilla ... Since my baby left me, well, I found a new place to dwell, you know the story. I was so lonely I could die." Elvis denied rumors of a comeback tour but revealed that he might open for "Killdozer" at O'CAYZ Corral "if the price was right."



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