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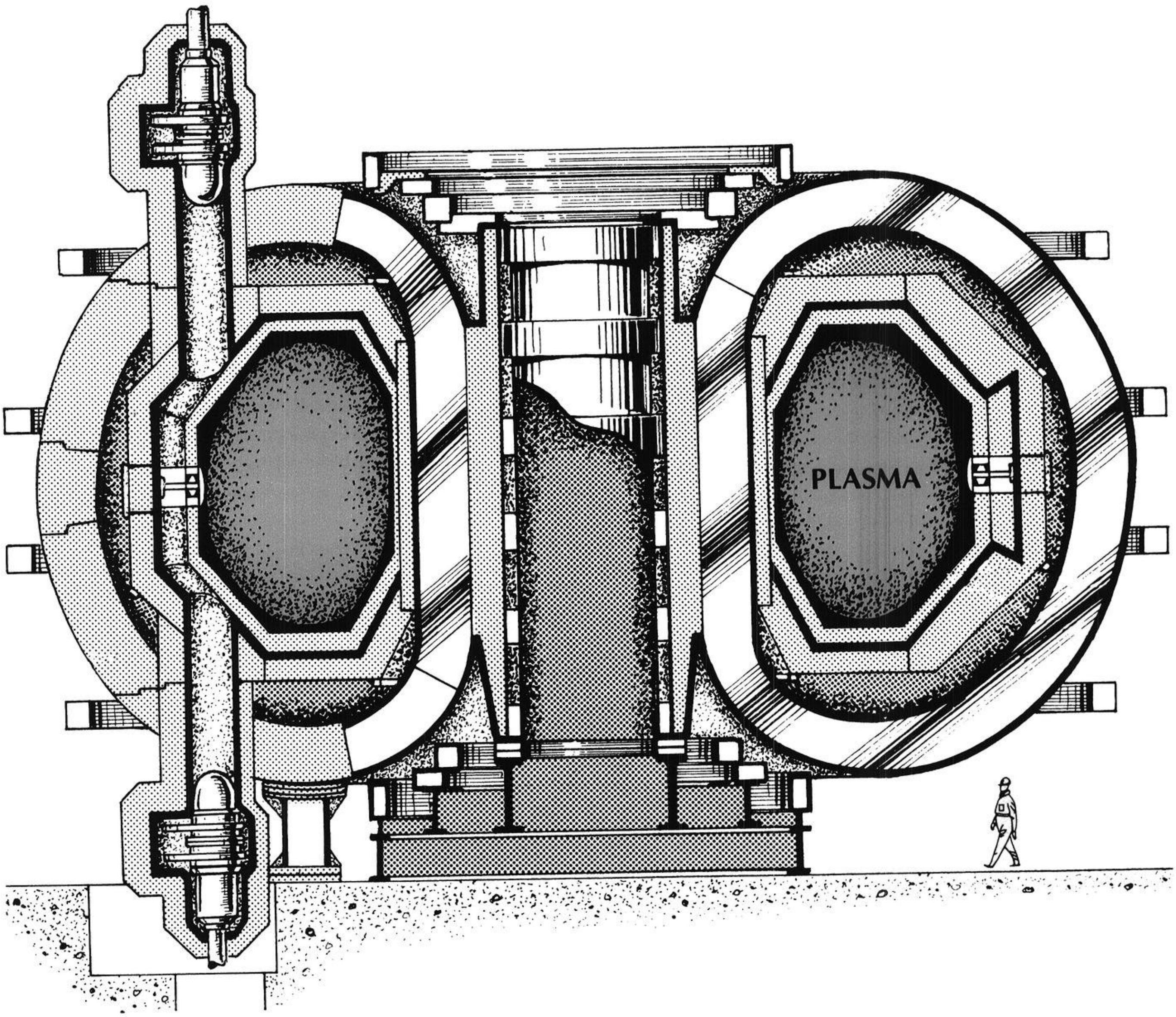


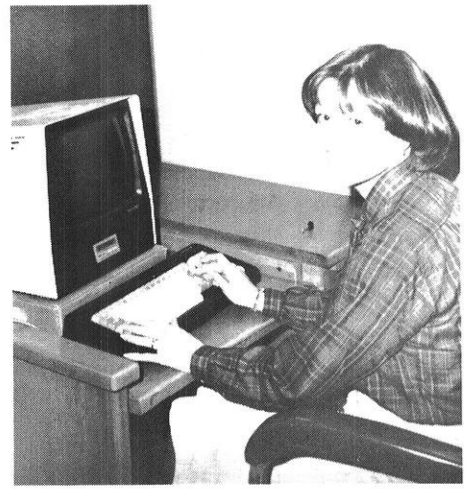
PLASMA: Hot Stuff

wisconsin engineer

PUBLISHED BY THE ENGINEERING STUDENTS OF THE UNIVERSITY OF WISCONSIN-MADISON. June, 1983

COLUMNS

FEATURES



On the Cover:

The tokamak, a doughnut-shaped nuclear fusion reactor will magnetically hold and squeeze a plasma to produce a fusion reaction. Diagram courtesy of Argonne National Laboratories.

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Keeping Plasma in Magnetic Bottles

by Lynn Liewen

Through the study of plasma physics, nuclear fusion, a safe and practical form of energy production is nearly developed. Fusion deals with the process of heating Hydrogen (H_2^1), Deuterium (H_2^2) or Tritium (H_2^3) to a temperature of approximately 10^7 °C. At this high temperature, the atoms dissociate and form a plasma (free ions and free electrons in the same vicinity.) If one can confine this plasma for a long enough time at high pressure and energy levels, the hydrogen nuclei will fuse together and release much energy in doing so. The trick is to get more energy out of the reaction than was used in heating and containing the plasma. However, many problems arise when trying to confine it. What kind of a container can be used to maintain a substance that reaches temperatures as high as 10^7 °C?

The University of Wisconsin Electrical and Computer Engineering Department is working on this very problem. The department's Stellarator Lab has two devices that are used primarily to study plasma confinement. One method, called the inertial method, uses lasers to hit a Deuterium or Tritium pellet from about eight different angles. The pressure causes it to collapse inward upon itself. It exists as a dense ball for a brief time while held together by its own inertia. This method has been tested by Lawrence Livermore Laboratories and densities of up to 10,000 times the density of solid mass have been reached. It is only when pressures of enormous magnitude are reached that the fusion reaction can occur.

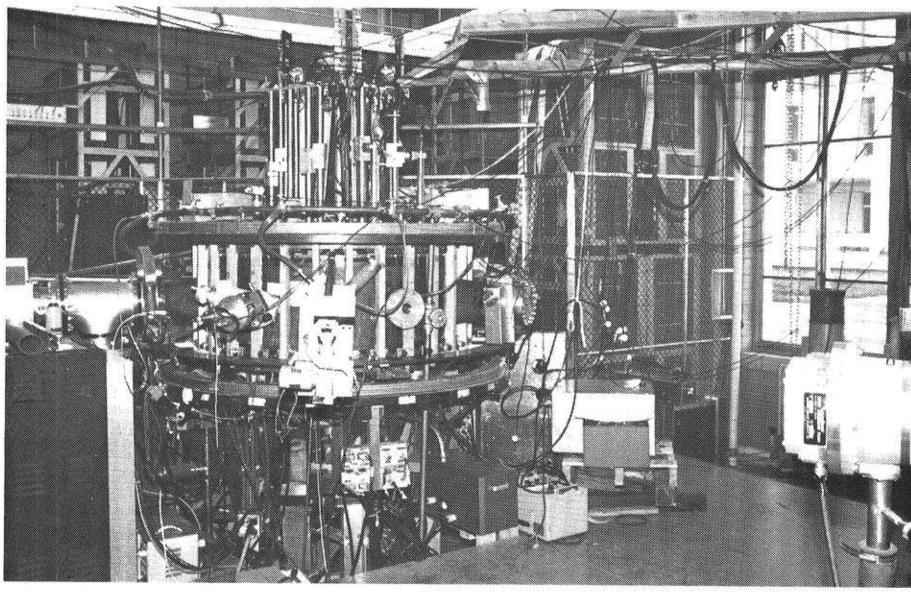
What kind of a container can be used to maintain a substance that reaches temperatures as high as 10^7 °C?

The other method that is more commonly used is magnetic confinement. Magnetic confinement holds the plasma together by generating closed toroidal magnetic surfaces. In order to generate such surfaces in a torus, it is necessary to keep the magnetic field lines from closing on themselves after one pass around the torus. This is done by introducing a twist in the poloidal direction.

Two basic schemes for achieving this type of magnetic confinement are the tokamak and the stellarator. Tokamaks provide the necessary twisting of the magnetic field lines by passing a current in the toroidal direction through the plasma. Stellarators provide the twisting by means of either a deformation in the torus itself (twisting the torus into a figure 8) or by using a set of twisted helical coils.

The ECE Department's Stellarator Lab contains a Torsatron and a Proto-Cleo Stellarator. The Proto-Cleo Stellarator uses both toroidal and poloidal helical windings to produce a magnetic field of whatever shape is needed to best confine the plasma. The Torsatron Stellarator produces a similar magnetic field but does not have separate toroidal and poloidal helical windings. It uses a single set of helical windings that all carry current in the same direction.

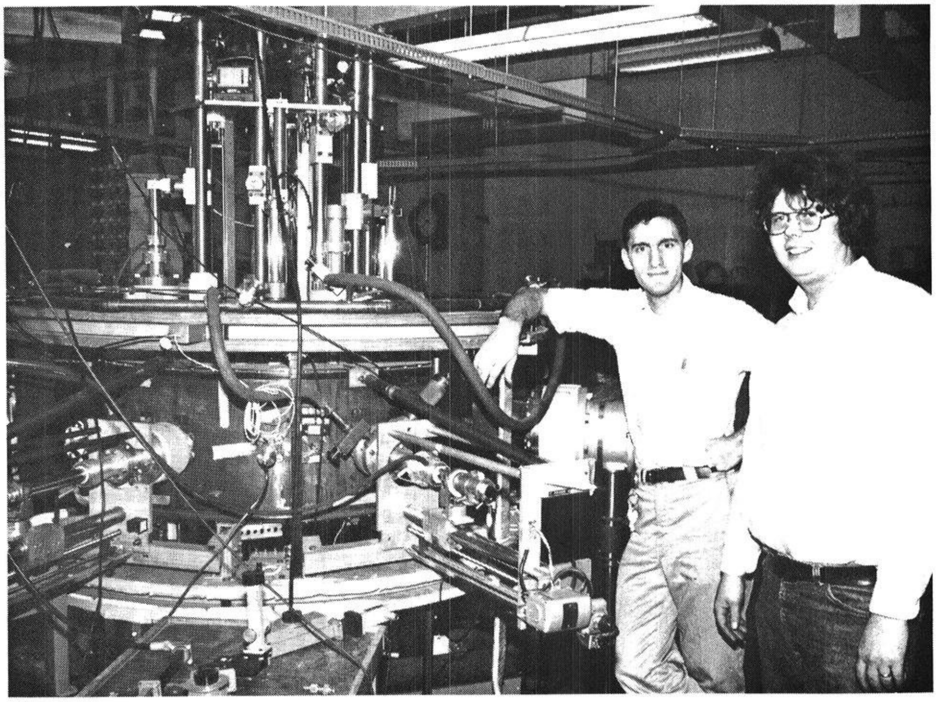
The plasma used in experimentation is obtained by loading a titanium washer gun with hydrogen gas. This gas is subjected to a high voltage (approximately 10 kilovolts). The hydrogen gas is drawn out of the titanium washers and ionized, thereby producing a base plasma. At the onset of the experiment a three Farad capacitor bank is fired, which causes current to flow through the helical windings. Within about 20 milliseconds the current flowing through the magnets reaches a peak (called a flat top) and a "magnetic bottle" is formed. The plasma is injected into this via the titanium washer gun and will last there for about 10 milliseconds. The ions in the plasma will reach an energy level of about 60 electron volts and the electrons will reach an energy of about 4 electron volts. The density of the plasma is approximately 10^{12} particles per cubic centimeter. After the 10 milliseconds the plasma will decay to one third of its original density.



This Proto-Celo Stellarator could be the solution to the fusion problem.

A CZAR timer is used to synchronize all the events. This master timer consists of ten separate timers linked together. They control the firing of the capacitor banks and plasma gun, and also start and stop data collection by a camac crate. The camac crate is controlled by a PDP 11 through a computer system. It samples data at a rate of a million per second. There are also various other diagnositics that are controlled by the timers depending on the type of experiment being conducted.

The Torsatron and Proto-Cleo Stellarator are two very elaborate machines. These two devices were prototypes for a larger stellarator built by Culham Laboratories of England. Culham was essentially ready to junk them because they were just occupying a corner when the University of Wisconsin came to their rescue. Wisconsin paid a mere $20,000 for the two machines. Today they are worth over half a million dollars apiece, and doing a terrific job of providing answers to some of the confinement problems raised in the study of plasma physics. □



Academic Staff member Dave Anderson and graduate student Richard Bonomo take a break next to the Proto-Cleo Torsatron, one of the plasma containment devices located in the ECE Department.

IE Research: Today's Teens Can Go Ask BARNY

by Dave Yngsdal

The Body Awareness Resource Network (BARN) is a three-year joint project of the Industrial Engineering and Health Services departments with the purpose of creating interactive computer programs to be used by teenage students for guidance regarding common health problems that affect them. Some of the topics addressed by the BARN system are alcohol and drug use, smoking, sex and teenage pregnancy. These are often subjects that are very difficult for a teenager to discuss with his parents or friends and when questions arise in these areas the teen is often left with no place to turn for answers. That is where the BARN system (also known as BARNY) comes in. BARNY is specifically designed to provide the adolescent with an unbiased and non-judgemental source of information on these and other topics. BARNY can also be used as a referral service to direct the teen to other sources of information or help.

Although BARNY is intended to be used by all adolescents, its primary goal is to reach those who are presently on the borderline of deciding, for example, whether or not to use drugs. By reaching them during their time-of-decision it is hoped that by using BARNY's resources they will be able to make a more informed and intelligent decision than they would have otherwise.

At the present time the BARN system is being used in five Madison area schools. When the system is put into a school it is explained to all the students in the school by a series of presentations during their homeroom period. Like many home computer programs, the BARN system leads the user through the programs quite smoothly, requiring no previous computer experience by the student.

After the system has been demonstrated to the students they are then allowed to use the computers during any of their study hall periods. Giving the students a chance to get out of their study halls and use the computers definitly added to the overall appeal of the system and his has resulted in BARNY being a very popular addition to the school.

The BARN system deals with some of the most important problems an adolescent must confront. Often their decisions will affect the rest of their lives. And since these decisions seem to be coming earlier and earlier in a teenagers life, the BARN system looks like an idea that's right on time.

Funding for the BARN project is being furnished by the W.K. Kellogg Foundation. □

Social Values Influence Productivity

by John Wengler

Agricultural progress can be achieved through changes in social values, a UW researcher said recently. Future harvests are dependent not only upon farming methods, but also upon national import policies, conservation practices, and consumer attitudes. "It is partly a value problem, not just a technology problem," said Prof. Herman Felstehausen of UW-Madison's College of Agriculture. He addressed a meeting of the Friends of the Earth, an environmental group concerned with organic agriculture.

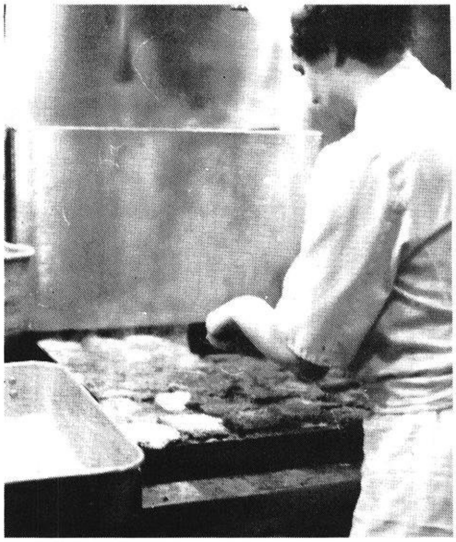
Prof. Felstehausen perceives the nation's meat diet as one reason for agricultural inefficiency. American farms are presently feeding 85 to 90 percent of their grain to animals. Since 100 calories of grain can create only one calorie of meat, this grain could feed a great many more people if used directly as grain. Protein substitutes, such as fish and soy beans, could further relieve dependence upon meat consumption and offer a better diet.

The pursuit of efficiency in the agriculture industry not only decreases food prices, but also increases the nation's unemployment rate.

Felstehausen sees broader implications of excessive meat consumption. Economically, the U.S. must import meat to satisfy demand, thus affecting the already ailing balance of trade. Using political means, U.S. importers are also encouraging Central American countries to convert farmland over to less efficient meat production. The exportation of meat to the U.S. drains a developing nation's ability to feed its own population.

Festehausen claimed a change in national attitude could solve this problem. "It is a tokenism for an individual to try solving the problem by eating one less hamburger," he said. "It is better to come out against our import policies."

Food consumption is directly connected with food production, which Felstehausen finds to be "build on the notion that we can extract more product per acre" by using chemicals and machinery. People expect technology to continually increase crop yields.



The American meat diet supports an inefficient agricultural system and should be modified.

But intensified farming practices have already pushed the soil's production capacity to its limit. "Soil erosion (in the corn belt) has reached its tolerance level," Felstehausen pointed out. Scientists have concluded that the average five tons of soil per acre that eroded last year is the absolute maximum loss that the environment can handle. Iowa farmland is already losing ten tons per acre per year to erosion, and Missouri's loss is believed to be twice as large.

Felstehausen believes a rising conservation ethic among Wisconsin farmers will lead to better planting and rotation methods, yet he maintains that consumer attitudes must be enlightened as well.

Consumers continually demand lower prices and expect farmers to make them possible by increasing productivity. Under such pressure, many farmers have little choice but to forego conservation practices and follow short-term, high-yield awareness of agricultural limits would in turn decrease the pressure felt by farmers.

The agriculture industry's pursuit of efficiency not only decreases food prices, but also increases the nation's unemployment rate, Felstehausen claimed. In the spirit of productivity, large-scale farms have become abundant in the U.S. These "super farms"

A change in national attitude could solve this problem.

number only 12,000 of the nation's total one million farms, yet they produce more than half of America's crops. By replacing people with machinery, labor costs are reduced and profits increase. In 1950, labor comprised 40 percent of the input to agriculture, while in 1977 it was merely 14 percent. In these days of high unemployment, Felstehausen claimed mechanization was "strange since we are presently seeking more jobs for people."

The spread of super-farms has also pushed thousands of small farmers out of business. Career opportunities for younger independent farmers are therefore severely limited. Felstehausen said that since the average Wisconsin farmer is 50 years old, we must open careers for the rural youth to avoid their continued migration to urban areas. Ironically, Wisconsin's Department of Labor reported that the number of jobs in agriculture is decreasing while the major area of job growth is found in fast food restaurants.

"I wouldn't call a job at McDonald's a career," commented Felstehausen.

Felstehausen concluded that standard agricultural policies for greater productivity don't allow people to face the long-term effects of contemporary farming practices. "We need to put more pressure on research," he said, to define the relationship between socio-economic values and agricultural technology. The results from such research could then be used by consumers and farmers alike in planning American agricultural strategies. □

Dr. Seuss Goes High-Tech

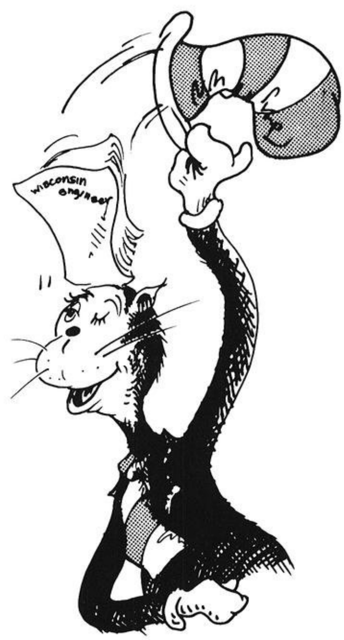
by Solveig Christenson

The sun did not shine.
It was too wet to play.
So we sat in the dorm
All that cold, cold wet day.

I sat there with Sally,
Simply procastinating.
We had so much to study
It was somewhat exasperating.

Too tired to do problems,
Or work through solutions
For out four-hour lab
On industrial pollution.

And that Horrible Feeling
Of accomplishing nothing
As time ticked on by
Was simply disgusting.



And then,
Something went BUMP!
How that bump made us jump!
We looked ('cause it wasn't
the stereo's thump).

And we watched him come in
An odd looking fellow
All shrouded in wisdom
Yet not gloomy or mellow.

With a grin that was friendly,
And a gait that was clumsy,
He entered the room,
And announced rather chummily:

"I'm the Engineer in the Hat, you see,
And I know it is wet,
And the sun is not sunny,
And graphing equations
Is surely not funny.

But I know of something,
Yes, something to do
Where you can earn credit
And have fun at it too.

The **Wisconsin Engineer**
Has a foolproof way
To involve all students
So play really will pay.

Come along and we will see
Our magical office
At Room 460 M.E.
The staff is the key
To interesting leads
For suiting yourself
To that life-spice you need."

We sighed to each other,
Sally and I,
As we pulled on our raincoats
To go with this guy.

On the fourth floor
At the top of the stairs
The staff members lounging
Did not put on airs.

Betsy, the editor
Welcomed us then.
And without worry or fret
Told us she was sure
That we'd be an asset.

Sally and I were curious,
So on the couch we sat,
While the oracle of wisdom,
The Engineer in the Hat,
Told of adventures
Of this and of that.

"It is splendid to join
Before your brain festers.
The **Wisconsin Engineer** gives credit
At one per semester!

Our members gain experience -
Very important for times
When company recruiters
Are cutting fine lines.

The office is available
To staff members always,
For typing or reading,
Or fine music listening.

Of course there are deadlines,
To get the work done,
We need your involvement;
There's a place here for everyone.

Editors are needed,
For layout and features;
Photographers and artists
Can create grisly creatures."

By this time we two
Had been welcomed and given
A phone list of members
And an office key to get in.

We felt right at home
And knew we'd succeeded
In making our time
Worthwhile and needed.

As that jolly companion
The Engineer in the Hat
Walked with us home
And said, "Well, that's that."

He winked and he left us
But we often went back
As happy, active members
Whose lives never did lack
The excitement we found
With the magazine staff.

Our credit to *The Cat in the Hat*,
Dr. Seuss, Random House,
New York, 1957.

The Acoustic Detection

Scientists have studied microstructural discontinuities in high-carbon steel since the early 1920s. By monitoring acoustic emissions, a materials research engineer at the General Motors Research Laboratories has arrived at a more detailed understanding of how one type of discontinuity occurs.

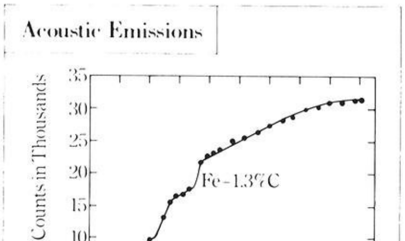


Figure 1: Cumulative acoustic emission counts for Fe-1.3%C steel, and control specimens of SAE 4140 and 304 stainless steel.

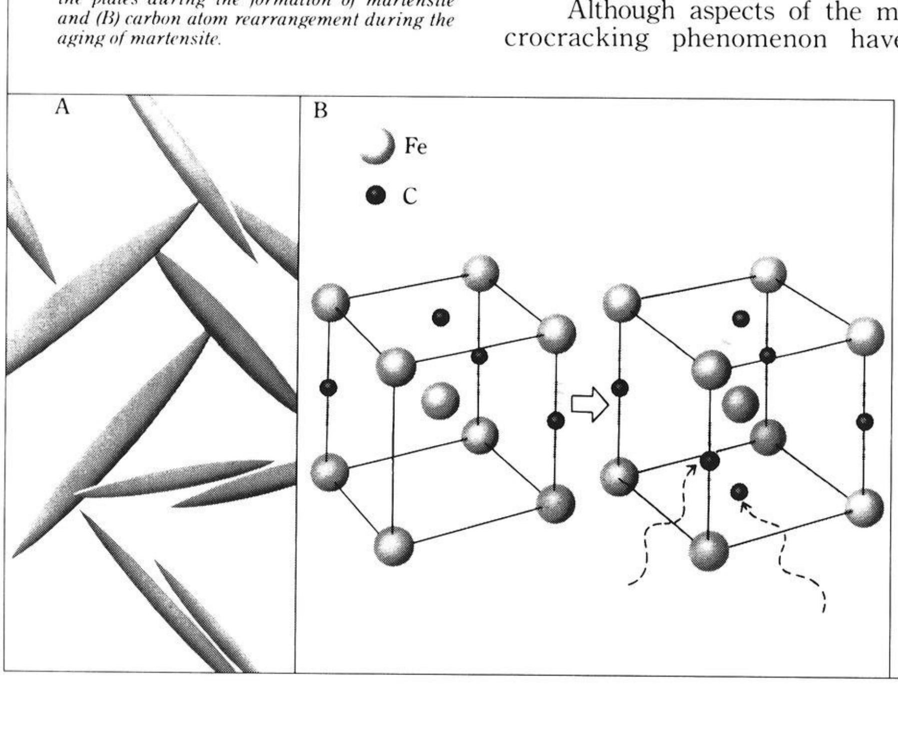
Figure 2: Artist's rendering of two proposed sources of microcracking: (A) impingement of the plates during the formation of martensite and (B) carbon atom rearrangement during the aging of martensite.

MARTENSITE is a hard microconstituent of steel which forms when austenite, iron containing carbon in solid solution, is quenched from a high temperature. The martensitic transformation produces steel that is hard and strong, but non-ductile. Through heat treatment, the steel can be tailored to applications requiring different degrees of ductility. High-carbon martensite—a highly stressed microstructure with a plate-like morphology—contains microscopic ruptures or separations 10 to 20 microns in length. These structural discontinuities, termed "microcracks," influence the mechanical properties of steel.

Although aspects of the microcracking phenomenon have been understood by metallurgists for more than fifty years, there is still no definitive explanation for when or how it occurs. An engineer at the General Motors Research Laboratories has devised an experiment that detects the microcracks as they occur.

The elastic energy released when microcracks form should produce a stress wave and associated high-frequency acoustic emission (AE). Using a piezoelectric transducer as the monitoring device, Dr. Michael Shea set out to determine what could be learned about the microcracking process by measuring AE.

The more widely accepted of two current hypotheses—the "impingement model"—asserts that microcracking is transformation-induced, taking place due to the collision of martensite plates during the quench. The other model maintains that microcracking occurs during the aging of martensite after the plates have already formed. The "aging model" suggests that thermal activation enables carbon atoms to rearrange themselves, producing localized stresses high enough to cause microcracking. Dr. Shea's ongoing research into high-carbon martensite led him to believe that the aging hypothesis was important. He proceeded to determine if AE is produced during aging.



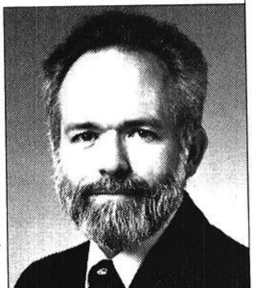
For his study, Dr. Shea chose Fe-1.3%C steel, which undergoes martensitic transformation during quenching and is known to form microcracks. To provide baseline data, control specimens of 304 stainless steel and SAE 4140 steel were put through the same procedures as the test composition. When quenched, 304 stainless steel produces no martensite, and SAE 4140 forms a low-carbon martensite which has a lath-type morphology, and generally does not microcrack.

SPECIMENS of the three compositions were quenched to -196°C and then slowly heated to room temperature. Acoustic measurements were made beginning at 0°C, at which point carbon atom mobility is sufficient to allow rearrangement processes to take place, and continued for 45 minutes after the specimens had reached room temperature. No AE was recorded for 304 stainless steel, and only a slight amount for SAE 4140. Significant emission, however, was measured for the Fe-1.3%C steel specimen during the entire testing period (see Figure 1). Since martensite had already formed during the quench, these results support the hypothesis that microcracking is produced during aging of the freshly-formed plates. Dr. Shea ruled out both slip and twinning as sources of AE since the literature indicates that neither factor is significant during aging of martensite below 40°C. The possibility that the AE resulted from isothermal transformation of austenite to martensite could also be excluded because this process does not take place in the composition studied.

"These results demonstrate conclusively," says Dr. Shea, "that microcracking occurs during the aging of high-carbon martensite, thereby providing support for the less accepted of the two models.

"The next challenge," he continues, "will be to quantify the relative contributions of both models—impingement and aging—in an effort to determine which, in fact, is the more important mechanism, thus furthering our understanding of microcrack formation. Then, perhaps, we can more systematically explore ways to minimize microcracking."

THE MAN BEHIND THE WORK



Dr. Michael Shea is a Staff Research Engineer in the Metallurgy Department at the General Motors Research Laboratories.

Dr. Shea received his undergraduate and graduate degrees in metallurgical engineering from Michigan Technological University, and his Ph.D. in materials engineering from Rensselaer Polytechnic Institute. His thesis concerned deformation and fracture of cesium chloride type superlattices. He joined General Motors in 1971.

The areas of metallurgical research pursued by Dr. Shea at General Motors include the mechanical properties of high-carbon steels, mechanically-induced transformation of austenite, and structure/property relationships in nodular cast iron. His exploration of the microcracking phenomenon in martensite was conducted with the help of instrumentation developed by GM colleague Dr. Douglas Harvey.

A Freshman's Guide to Everything

by Scott Paul

I'll bet the only information a lot of you have learned about UW-Madison to date has come straight from the college catalog. So in order that you may get the straight story on what Madison is like, I will share what I know with you. I'm very qualified to do this as I am an unbiased observer and have had much experience as a freshman here. Compiled below is a comprehensive glossary of information concerning the most important aspects of everyday college life.

Registration: Don't worry about it. All those horror stories can't possibly be true.

Consumption of Alcohol-Related Products: A freshman engineering student should alway bear in mind that his purpose for coming to college is not to carouse and have fun all the time. You are here to gain an intricate understanding of the physical principles that govern the universe. Never lose these lofty ideals. But if you insist, do not say that you are drinking; say instead that you are studying drinking.

Dorm Food: As a rule, nobody likes dorm food. The food lines are often long and this puts people in an irritable mood while eating. Also, the food is drab and boring. The food service staff does try to make things seem more interesting by using creative new names for the same old meals. But the fact is that whether you call it Cro Magnon Paper Mache or Tuna Turnover, it still doesn't taste good.

Many students decide to switch to a smaller meal plan. I recommend that you sign up for the smallest meal plan possible. If you find that you need more meal tickets, you can easily find other students who will sell you theirs. All year long there are ads on the dorm bulletin boards offering to sell meal tickets at bargain prices.

Mail: As the year goes on you may be disappointed to find that you don't receive as many letters as you did at first. You should not jump to the obvious conclusion that all your friends and relatives are dead--this may not be so. Your roommate may be hiding your mail. Or perhaps all the people you ever cared about just forgot you ever were alive. In any case you may find yourself depressed because you aren't getting enough mail. There's not much you can do about this except wait patiently and write a lot of letters to other people so that they will feel guilty and write back to you.

Study Habits: In order to have a successful college career, it's essential that the freshman engineering student develop effective study habits. This means spending long hours in one of the many libraries. If you are at all serious about studying do not try to do it in your dorm room. There are too many things that you will find to do instead of your homework--and it's a known fact that you can't absorb knowledge by sleeping on your books. Go

someplace where you'll be able to concentrate on what you're supposed to be concentrating on.

Lectures: Another ineffective educational practice is that of napping during class. If you do this you will not learn anything and you could probably sleep better in your room. So either stay alert or stay home.

Roommates: Sharing a room is not easy for some people to accept, nonetheless you must learn to cope with your roommate's annoying behavior. (Roommates inevitably exhibit strange behavior.) Do not kill him or set fire to his side of the room--you will accomplish nothing. A healthy roommate relationship is only achieved through tolerance and patient understanding of the fact that your roommate is probably sick of you too.

Safety: The Madison campus is not particularly dangerous, however incidents do happen. If you are careful to avoid areas that are poorly lighted you should never have any problems. Use your head.

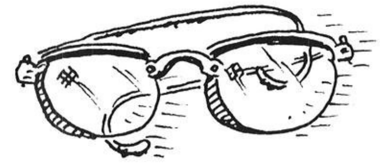
Extra-curriculars: Now is the ideal time to get involved in an activity that interests you. Organizations offer a chance to meet new people who share the same interests as you. They can also serve as a temporary escape from studying. There are many different sorts of clubs and organizations here, so you may even decide to get involved in an activity you've never had a chance to do before. Ask around--you'll have no problems finding something that's right for you.

Therapists: There are 85 psychiatrists listed in the Madison Telephone Directory. If you don't need one then your roommate probably does.

Weirdos: People around Madison frequently go to great lengths to stand out in a crowd. This is one of the few places you are likely to see outlandishly clad punkers eating in the same restaurants as businessmen in three-piece suits. And on State Street one can frequently find representatives of assorted religious organizations and political philosophies peddling their respective ideas to anyone who will listen. Occasionally you may overhear a bag lady or quarter man talking to his/her invisible friend.

There is no doubt that the cultural enrichment you will derive from living here is at least as valuable as what you will learn in classes. Mad City is a place where thousands of people come to find themselves each year.

Entertainment: There is a wide assortment of night clubs and bars in Madison. You will have many opportunities to see big name bands and performances by local groups. Plus, about a dozen movies are shown each week at various locations on campus. In fact, you can find about any form of entertainment that interests you here at Madison. However, there is one thing you should always bear in mind: if you're really enjoying yourself you should probably be feeling guilty. □



Engineer's Library

Samuel Florman, in his book, *Blaming Technology: The Irrational Search for Scapegoats*, tries to show the engineer's side of the story concerning the ill effects of technology. He takes to task the "anti-technological backlash," hoping to show conclusively that it is caused by an irrational fear and that technology is actually well under the control of the public.

Florman's qualifications are impressive. He is a vice-president of a major construction firm as well as a widely published author. His work includes 50 articles and three books dealing with the relationship between technology and society. Florman's ideas should be examined, if for no other reason, because they are the most widely known apologetics for technology. Unfortunately, there is good reason to doubt the validity of his arguments.

Florman begins by attempting to characterize the causes of the anti-technological movement. He states that anti-technology sentiment is nothing other than a "phobia" that arises when people try to control their anxieties about life by blaming somethin else. Another way to look at the "movement," he says, is to see it as postoralism, "an ancient mode of thought embodying a negative response to social complexity and change." He spends most of his time, however, illustrating how "academics" and authors have been promoting this phobia and thereby "spreading fear and paralysis" when trying to prod people into taking action against the ill-effects of technology.

It is all too apparent, unfortunately, that Florman has assumed that the average person lacks the intelligence to look past the anti-technological propaganda to form his own opinion. The public is fed an image in which techology runs rampantly out of control. Florman sets out to dispel this image by trying to show that everything is, in fact, controlled by the public as consumers. Florman concludes that his opponents have created the problem by using their "majestic intellects" rather than by observing the world around them. (If his sarcasm of academic intellectualizing is well placed, how does Florman set apart his own intellectualizing?)

After setting the stage by describing his opponents, he launches into an attack on common anti-technological myths. He begins by reassuring the reader that everything is okay in the market-place because the survival of any new product is ultimately controlled by the consumer. To help prove his point, he cites a large overblown example of how hard the rotary engine was pushed and yet failed. He goes into many other examples of technologies that never got off the ground but neglects such horrifying contradictions as the Dalkon Shield, Teflon-jacketed bullets (will penetrate any available bullet-proof vest) and other similar marvels of science.

Following the chapter that convinces the reader of his/her control over products in the marketplace, Florman reassures us that "this means we are still, however precariously, in control of our own destiny." (?!) Florman has correctly assumed that one of the things bothering people about technology is their inability to control the types of consumer products they have to choose from. He ignores the possibility that people might be intelligent enought to think about this; that they are more concerned for example, about how technology in the form of the mass media is manipulating their reasons for choosing a product. Florman exhibits an astonishing and disconcerting naivete when he states "advertising, like technology, is one of the abstractions that people tend to blame when the world disappoints them."

Florman creates his own Waterloo when he continues his defense of technology with a chapter on the Army

continued on page 11.

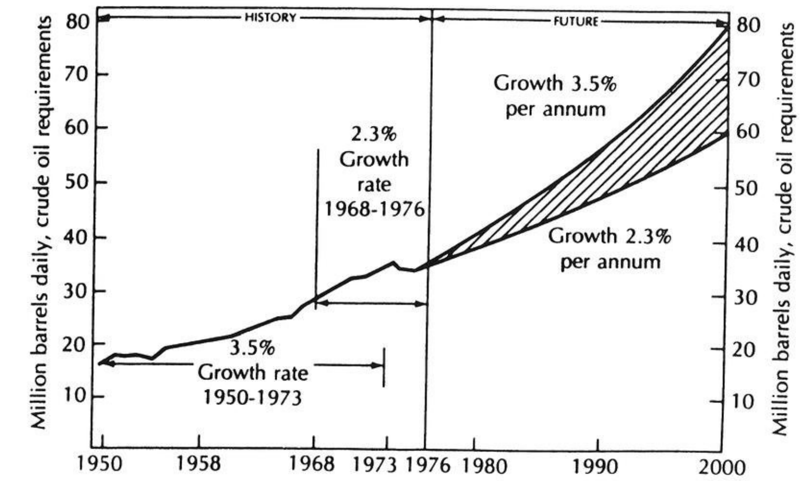
Planning for the Future

by Terry Mackey

Recently, national attention has been focused on such issues as the economy, unemployment, and nuclear disarmament. Concern about the energy crisis has faded from the limelight. It is, nevertheless, an issue demanding consideration so that future changes occur rationally and smoothly.

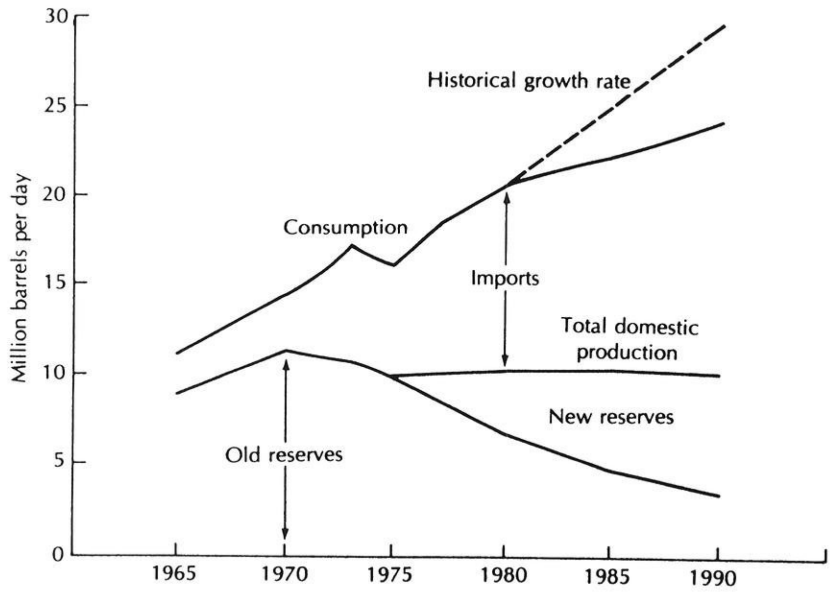
The energy industry is a major business affecting almost every facet of our daily lives. It is the "lifeblood" of our nation. Economists have long noted the close relationship between increased energy consumption and increased real GNP. This may lead many to believe that increasing energy usage is necessary for economic growth. Yet there is considerable fat in our daily consumption of energy. Most other advanced industrialized countries use far less energy per capita than the United States--Europe uses roughly half as much, Japan a mere quarter of our energy usage per capita.

The National Energy Act outlines some changes needed to deal with tomorrow's energy problems.



A lower growth rate can make a big difference in energy requirements. *(Source: U.S. Bureau of Mines.)*

As the U.S. depletes its nonrenewable energy resources, it must begin to rely upon renewable sources such as solar and wind. Much time, however, is needed to develop these technologies and get them "on line." Adequate planning in the national energy policy will allow for an effective changeover, and will assure us that our future energy mix is the best one for the U.S.



United States oil consumption, including natural gas liquids, without the National Energy Act (Source: U.S. Bureau of Mines and Federal Energy Administration.)

The Carter administration developed a policy that was passed by Congress in 1978 as the National Energy Act. It clearly defined our energy objectives as follows:

1) In the short run, to reduce foreign dependence and hence vulnerability to supply interuptions.
2) In the medium term, to keep our energy imports sufficiently low in preparation for ultimate world oil depletion.
3) In the long run, to foster renewable and essentially inexhaustible energy sources to ensure the possibility of sustained growth.

The strategies set forth in the National Energy Act will induce long range economic, political, and social changes needed to deal with the complexity of tomorrow's energy problems. Environmental protection must be maintained, and economic growth with high production and employment levels should not be constricted. And finally, the solutions chosen must be fair to all regions, sections, and income groups.

The cornerstone of this piece of legislation is the National Energy Conservation Policy Act (one of five sub-acts passed). Conservation is clean, inexpensive, and helps stretch out available supplies of nonrenewable energy resources. It is also the most effective means for protecting the environment. Unfortunately, conservation involves some sacrifice which many are presently unwilling to make. Yet the longer we wait, the more sudden and drastic conservation measures will have to be, and the less orderly the transition will become.

As the U.S. depletes its nonrenewable energy resources, it must begin to rely upon renewable sources such as solar and wind.

The changing of administrations in Washington brought an abrupt turnaround in governmental policies. Many key provisions of the N.E.C.P.A. were cut, such as appliance efficiency standards and the solar loan program. The Energy Tax Act was also hard hit. Tax credit programs designed to encourage the use of insulation and solar energy were cut dramatically by the Reagan administration.

Such actions have led to uncertainty in future governmental policies, and so have discouraged investment in energy

Conservation is clean, inexpensive, and helps stretch out available supplies of nonrenewable energy resources.

projects. This has further hurt alternative energy technologies and will delay their contribution to our energy supply.

As the result of all this confusion over U.S. energy policy, precious time is being lost. National attention is again needed in order to put our nation on the right track of sensible energy development. Only then shall we be able to smoothly make the ultimate transition to tomorrow's world. □

Reference:
The National Energy Plan, Executive Office of the President, 1977.

Engineer's Library

(cont. from page 9.)

Corps of Engineers. Here he hopes to persuade the reader that the Corps is simply being used as a scapegoat. He maintains that while the Corps is a victim of bad press, it is acutally "exquisitely tuned to work the will of the people" through its supposedly tight control by Congress. He goes on to tell us that local citizen's groups gaining political support are responsible for bringing Corps projects into being. And who makes up a "local group"? "Typically, the local group is a chamber of commerce or some other representative of monied interest."

He goes on to rationalize that even if the methods and circumstances bringing a project about are corrupt, it's acceptable because the local economy benefits because this raises the employment. (What?!) Florman's defense rests primarily on the supposed responsiveness of the Corps. He tries to placate the reader by stating, "but we can stop any new project at any time. All we have to do is convince ourselves and then our Congress that this is what we want to do." If this is supposed to prove that the Corps is "exquisitely tuned", that makes the Dodo bird the premier aerodynamic design of the animal kingdom.

It is interesting to read in chapter after chapter how Florman bases his arguments on the assumed ease with which people's ideas can be molded. In a chapter titled "Nuclear Angst", Florman does a complete reversal. He expresses his terror for nuclear power and then states "I am satisfied that many citizens together--blending sense and instinct, boldness and caution--are making the choices that must be made." There are many other glaring examples of contradictory thoughts and arguments throughout this book, but they will have to be left for the reader to find for his or her own intellectual amusement.

Blaming Thechology is an excellent example of how not to defend technology. The book is filled with interesting and often valid information which, unfortunately, in invariably used to come to unsatisfactory and misguided conclusions. Forman says it best when he states, "The tendency to express complicated problems in simplistic moral terms is often associated with liberalism." If this is the case, I would warn any would-be reader that this leaves Florman sitting somewhere to the left of Abbie Hoffman.

--*Reviewed by Paul Jursik.* □

UW Engineering Lab Spins Up Portable X-Ray Machine

A research team in the engineering college's Instrumentation Systems Center has developed a portable X-ray machine that is only half the size and weight of present portable machines but yet produces diagnostic quality X-rays.

The workbench model uses a 10-inch flywheel to store energy from a normal electrical wall outlet, and releases it in bursts through a modified helicopter alternator to produce the 25,000 watts needed to take a good medical X-ray picture.

Melvin P. Siedband, a medical physics professor who headed the project with four graduate students, said the group broke no new ground by picking a flywheel to power the X-ray machine. Rather, he said "We solved the technical problems" that had stymied flywheel use.

"The big problem is that to make decent X-rays you need an indecent amount of power," Siedband said. Traditional solutions in portable machines have required large battery packs or giant capacitors. But battery packs are heavy, bulky and must be replaced occasionally. Capacitors don't produce enough energy for good X-ray images inside thicker parts of the body.

Melvin P. Sieband

Flywheel experiments have been tried before, Siedband said, but with heavy, slow flywheels. For technical reasons, they don't produce stable power and thus don't take good pictures. The UW-Madison team used a light, high-speed flywheel. They linked it to the high output helicopter alternator, and then produced electrical circuitry to stabilize the power output.

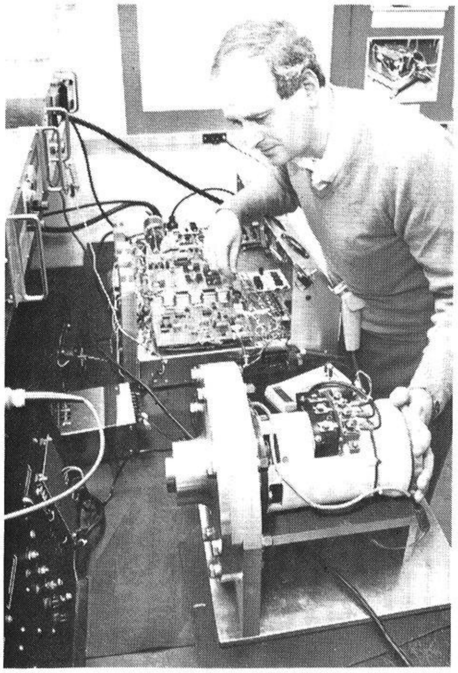
Their machine produces enough power for almost all medical applications, according to postdoctoral student and research associate Donald K. Showers. It can take half a dozen pictures before the flywheel has to be "spun up" to speed again. The spin-up process takes just a few minutes.

Efficiency became the name of the game during the 14 months of development. The flywheel runs at up to 12,000 rpm with little or no detectable vibration. The high-tech, military specification alternator -- which doubles as a motor to give the flywheel its initial spin -- is connected directly to the flywheel and runs on $150, low-friction bearings. The control circuits and high-voltage transformers are state-of-the-art.

The device draws only 500 watts, about the same as a curling iron, half that of a toaster. It can run from a wall outlet or small generator, and even could be designed to run off several car batteries. The device has applications not only for the U.S. Army, which provided a $113,000 grant to build it, but also for the Third World, rural hospitals, and, perhaps, industry.

The army is interested because it runs field hospitals, Siedband noted, and must haul diesel generators larger enough to power an X-ray machine as well as a MASH unit's ordinary lights and appliances. A small generator would be easier to haul and use a lot less fuel.

"Even though we're doing it for the Army, the rural and Third World implications are every bit as important," Siedband said. The Third World and many rural hospitals share the same power problems, he noted, and even major urban hospitals might find a



portable X-ray machine useful. Even industry could have use for a powerful, portable X-ray, he speculated.

When put in a single box, the UW-Madison machine will weigh an estimated 350 pounds compared to about 700 pounds for a battery-powered unit of similar X-ray quality. The box itself will measure about two feet square by four feet high.

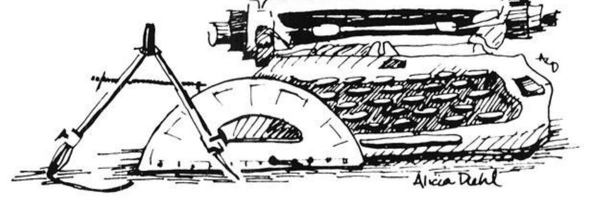
Although no serious studies have been done, Siedband said he is convinced a commercial flywheel unit could be sold at close to the $40,000 pricetag carried by today's battery-powered equipment. The Wisconsin Alumni Research Foundation is in charge of the commercial aspects, Siedband said.

The Army contract is up at the end of February, and the team expects a renewal contract to produce two field units for Army testing. "It's nice when you win one," Siedband said. "We did everything we set out to do. The thing really works."

Other students on the project are David Trumble, Joseph Kidder, and Scott Biederwolf. □

—Courtesy of UW News—

Bits & Threads



WSA Elections

Last spring, engineering juniors, seniors and grad students elected a new person to represent them in the Wisconsin Student Association (WSA) Senate. John Schenian, a Chem.E. senior, won the election with 187 votes. The SPC candidate, Brett Schneider, received 119 votes, while Jeffrey Needle, an independent, got 91 votes.--Daily Cardinal

Concrete Action

Any civil engineer adamantly believes that concrete is the the most apolitical substance in the world.

But concrete is being wielded as a political weapon by the community of Greenham Common in England. Last spring the city's council resolved not to grant road contracts to companies building ballistic missile silos. Tamarac Ltd., which was specifically mentioned in the resolution, is currently pouring the concrete for the silos and support facilities which will house some of the newly deployed Cruise and Pershing-2 missiles in England.

Greenham Common was one of over 100 communities to adopt city-wide nuclear-free referendums last year, but is the only city so far to take direct action in the form of denying employment to military contractors.
--*Shaw Walker*

Tower of Pisa Needs Help

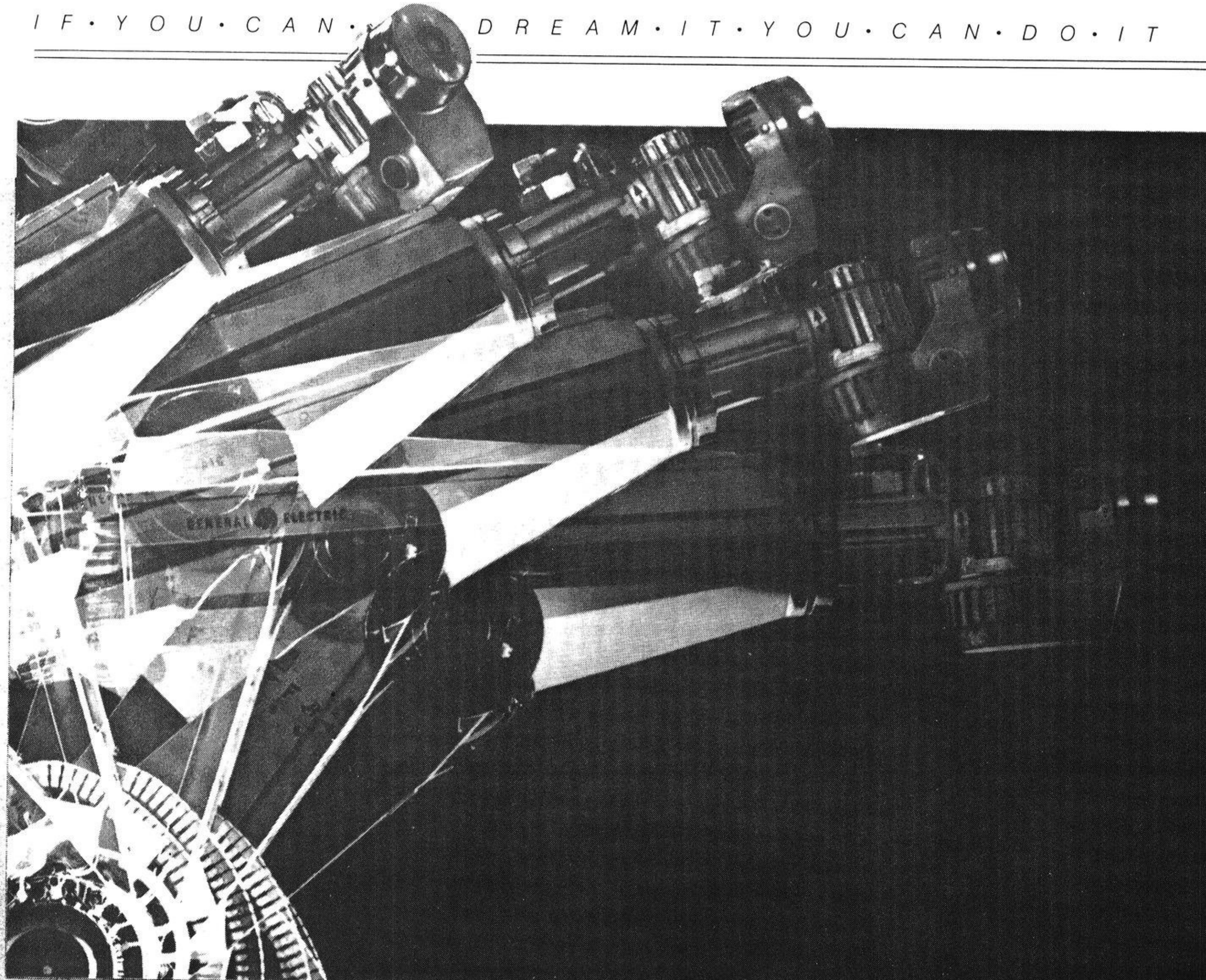
In Rome recently, the government asked six engineering, geology and art history experts to design a plan to prevent the Leaning Tower of Pisa from falling over. The tower's tilt is increasing and experts said it eventually will topple unless a support system is devised. The Public Works Ministry awarded the $7 million job to professors from the Universities of Pisa and Genoa and Milan's Polytechnic Institute.

A ministry spokesman said that while Parliament approved the appropriation of money last year for a project, the government first had to find qualified people to design a plan. He said its conception probably would take several years.

The tower is 17 feet off the perpendicular. It began leaning shortly after construction began in 1173 because the ground shifted underneath.

Wheels of Fortune

The Department of Transportation has come up with a brilliant plan to save lives on our nation's highways. This plan will not force car manufacturers to make safer cars. (In fact, car bumpers are now only required to pass a 2½ mph crash test instead of a 5 mph test.) According to DOT it is the driver's fault for not buckling up. The DOT has now renewed their efforts to get drivers to buckle their saftey belts by convincing the only two U.S. fortune cookie manufacturers to include in a certain percentage of their cookies the fortune "Confucious says: He who buckles up, saves face."--SftP Newsletter



Teach a robot the facts of life.

There was a time when most robots earned their livelihoods in comic books and science fiction films.

Today, they're spraying, welding, painting, and processing parts at manufacturing plants around the world.

Necessity has caused this amazing leap from fantasy to factory.

The world wants long-lasting, high quality products, now. And robots fit perfectly into this scheme of things: They can make those products – quickly, easily and accurately.

What kinds of robots? There is GE's Allegro,™ for one. It can position a part to within 1/1000th of an inch – or about ¼ the thickness of the paper this article is printed on. Or there's GP 132 (shown here). This loader, unloader, packer, stacker and welder – can lift and maneuver 132 pounds with no trouble at all.

So what's left for me to teach robots? You might ask. Consider this glimpse into the future by Dr. Roland W. Schmitt, head of GE corporate research and development:

"One of the big frontiers ahead of us is putting the robot's nervous system together with some senses – like vision, or touch, or the ability to sense heat or cold. That can give you an adaptive robot, one that can sense how well it's doing its job and make the adjustments needed to do that job better."

That's a tall order. And one we'll be expecting you to fill. With foresight, talent, imagination – all the things that robots have yet to learn.

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