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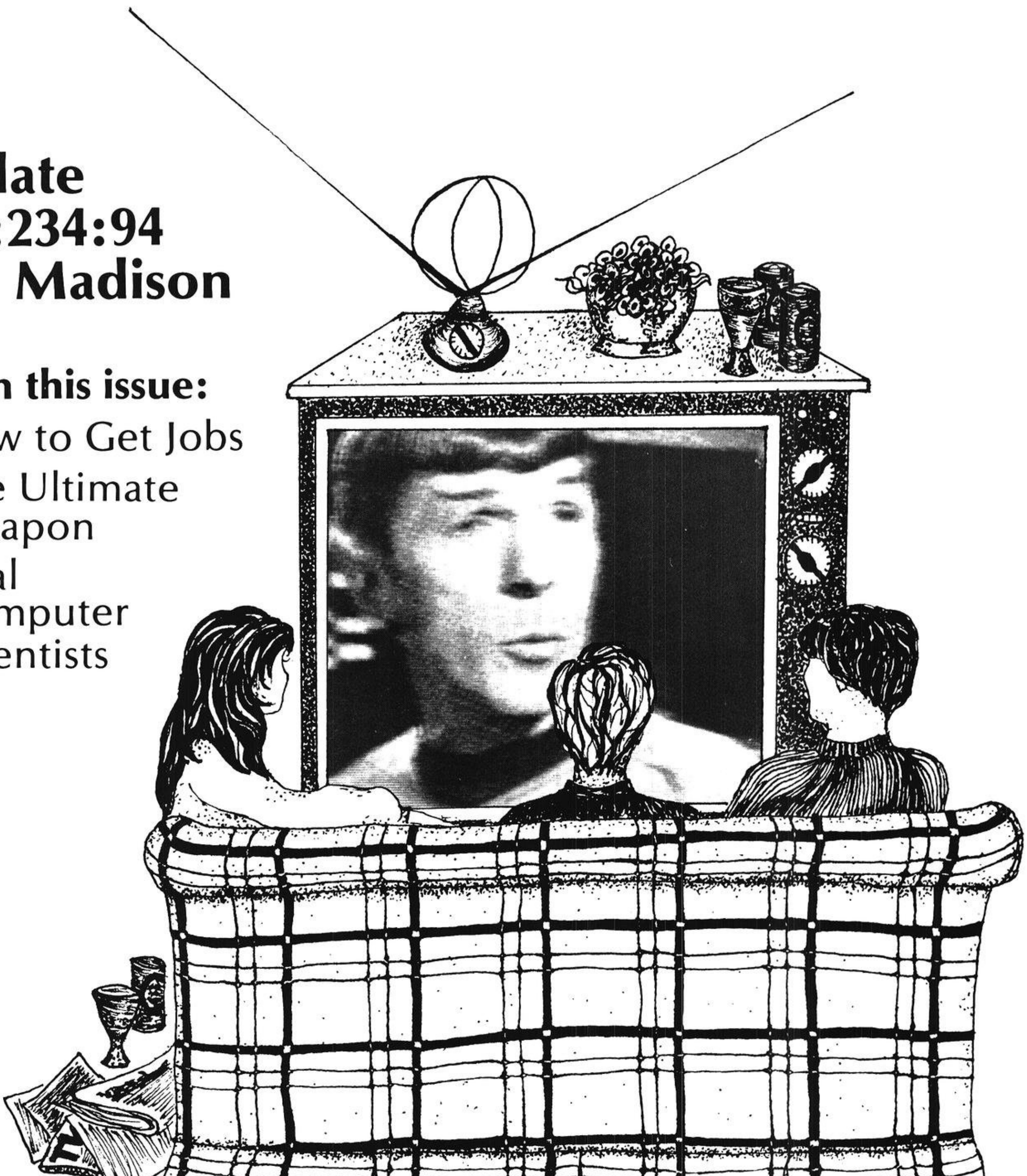
Volume 89, No. 2 December, 1984

wisconsin engineer

Stardate 26:234:94 -- Madison

Also in this issue:

- How to Get Jobs
- The Ultimate Weapon
- Real Computer Scientists



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A great place for engineers

wisconsin engineer

PUBLISHED BY THE ENGINEERING STUDENTS OF THE UNIVERSITY OF WISCONSIN-MADISON December, 1984

Columns

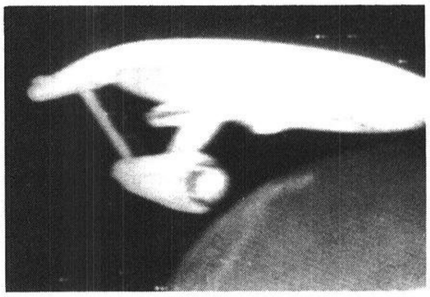

Photo by Kurt Worrell

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Features

This fall, the Wisconsin Engineer conducted a writing contest for which all university students were eligible. This issue contains three of the four prize winning articles. Alternatives to Library Study, the second place winner, was featured in our October issue.

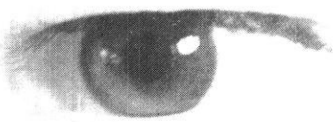

Photo by Kurt Worrell

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Lake Water
Brainpower and the Ultimate Weapon

By Scott Paul

I've heard it said that today's college students will become the leaders for our future. The most common justification for this opinion is that college students represent the most intelligent segment of young adults in this country.

I've been watching tomorrow's movers and shakers for some time now. They seem to have a lot in common. For example, almost every last one of them totes his or her backpack on one shoulder while commuting between classes. Backpacks have two straps. When a backpack is used properly you can carry a heavy load of books comfortably while still having the unrestricted use of both hands. However, because everyone else does, and because it's cool, college students generally walk about with one shoulder bunched up to their necks.

Another thing that college students have in common is that very few of them wear hats.

Another thing that college students have in common is that very few of them wear hats. This is Wisconsin; it gets cold outside. "It makes my hair look funny." "No one wears stocking caps any more—this is the eighties." And so day after day my roommate comes into the house with his pink ears cupped in his hands saying, "Damn it's cold outside!"

I'm not trying to start a backpack and stocking cap revolution; I just want to point out that it is very easy to find cases where members of the most intelligent segment of the population do things for stupid reasons.

This type of phenomenon has been understood for years, and in fact, we train people here at the university to exploit the irrational behavior of fellow humans—they're called advertising majors.

Graphic by Alicia Diehl

Matt, our Ad Director, explained this example to me. "Pepsi Cola pays Michael Jackson millions of dollars to go on television and sing about Pepsi. When the consumer passes the soda aisle in the supermarket he sees Pepsi and puts it in his cart because he has a good feeling about Pepsi because Michael Jackson is cool and everyone loves him."

We live in a society that faces serious and complicated problems. But all I ever seem to hear are simplistic solutions.

Economics has to be about the most complicated thing in the world. This fall I listened to the two men who would lead this country talk about its economic problems. "We need to raise taxes to wipe out the deficit." "Taxes will be raised over my dead body." Economics — bah humbug.

Simple solutions are for simple problems. "It's cold out, should I wear a hat?" Simple problem, simple solution.

I believe that there are solutions to the problems that face this nation. But I believe these solutions will require new and complex approaches to problem solving. New approaches are needed because the old ones have only met with limited success. Complex solutions are needed because the problem we face are also complex. I think we have the potential to produce those solutions in this generation, but whether or not we will do so is questionable. Original ideas don't come easily from people who do things because everyone else does.

Original ideas don't come easily from people who do things because everyone else does.

Dynamite was thought to make war impossible. We fought two wars to end all wars. Nuclear weapons were to bring an everlasting peace to the world —after we blew up a few Japanese cities. Now space weapons are viewed as a way to establish a lasting peace between nations. It's hard to believe that we can persist in such a simplistic and incorrect notion of diplomacy for nearly a hundred years. There will always be a better weapon. Lasting peace will never come about because of the number or sophistication of our weapons. It can only happen if governments representing widely different cultures can sit down and decide not to fight each other anymore no matter what. You may give reasons why that may never happen. Well I agree that it certainly will present a complicated problem and won't be easy to solve.

Any intelligent ideas, anyone? □

Editorial
The Observer

By Scott Knox

Who is the observer? The observer is a person who learns like a receiving antenna. Passive observers wait for information and ideas to come to them. They learn by "playing it safe." They come to class, pay attention, and talk only minimally. Many people observe as these students do.

Bob Fictitious is sitting in dynamics class. He has read the chapter and knows the steps for solving the problem being worked in class. When the T.A. asks "what's the next step?", Bob sits quietly behind his desk. The T.A. waits for a response; after hearing none, he continues with the problem.

In a lab class Hypothetical Sue is "observing" the lab procedure discussion. In the lab manual it was unclear what one had to do to find the proper pH. Sue decides to figure it out in lab rather than ask about it in discussion. A half hour later the instructor explains how to find the pH to Sue and five other who were having the same difficulties.

Bart Notreal is late to the group meeting and he still has not written his section about computer graphics. The group proposal is due the next day in class. Luckily, one of the other group members reads computer specs as a hobby and quickly writes up Bart's section. The group starts coordinating the sections into the final proposal. Bart feels relieved and says with a chuckie "looks good, I'll just watch."

These three scenarios are everyday examples of the opportunities missed to participate while learning. Very few people plan to be observers, it's just that they don't commit themselves to participate. Problems come as a result of such passive learning. The observer who knew the answer to the question missed the opportunity to use his knowledge and reinforce his understanding of the material. The women in lab discussion could have saved time in lab for herself and the other students, and missed an opportunity to correct a deficiency in the lab manual. Bart, unfortunatly, is under the delusion that he will gain the same experience by watching as by doing. Bart is not only hurting himself, but he is more of a hindrance than a help to the group.

Observers, very often, get through their classes. However, they don't succeed in the long run. Why? Because many occupations, especially technical ones that involve problem solving, require you to work in groups. Communication, needless to say, is an important part of working in groups. Many people hesitate speaking up in a group because it means taking a risk. What risk? The risk of being wrong and embarrassed. It's that old red-in-the-face feeling, or some refer to it as hoof-in-mouth disease. Don't worry though, neither of these has been determined to be permanent or terminal.

The college years are a great time to develop those participatory skills — the skills for asking questions, being a sounding board for the ideas of others, and participating in discussion. College, some people say, can be boiled down to answering and asking good questions. It takes time to learn how to ask "Good Questions," and now is the time to start. As it has been said in many other contexts, "Life is short." Don't sit and observe, participate! □

Contest Winner: Tied for Third Place

Sunday Night is "Trekkie" Time in Madison

By Stacy Swadish

On a Sunday night at the University of Wisconsin-Madison, most students are finally tackling a weekend's worth of homework. But to a large group of Madison "Trekkies," the homework stops once the words "These are the voyages of the starship Enterprise. Its five year mission . . ." are heard.

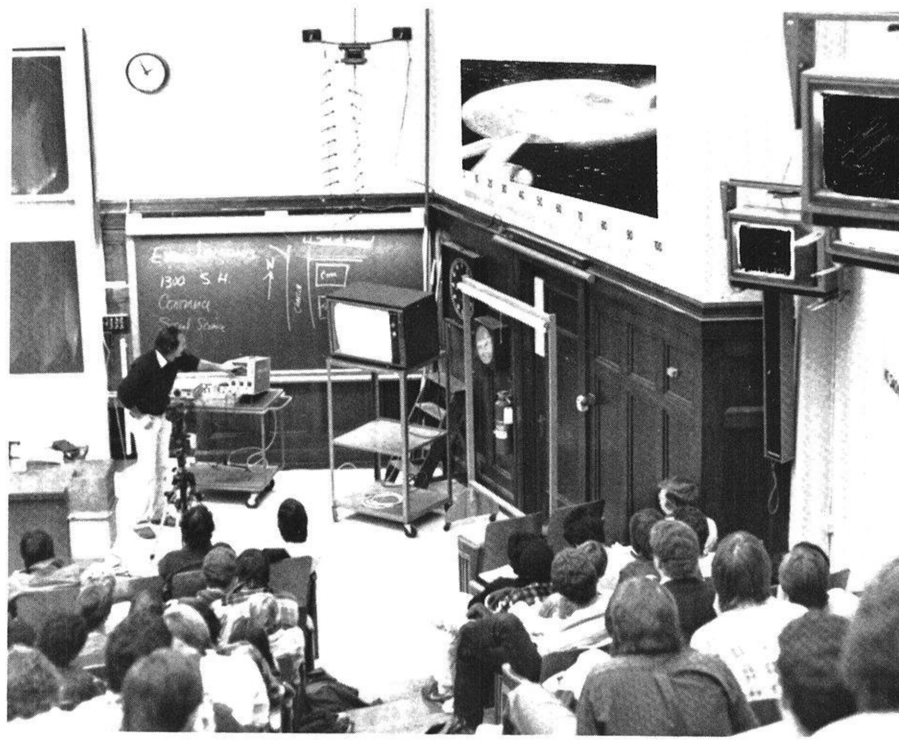
The television program Star Trek was first shown September 8, 1966. The show ran for only four seasons but it soon developed a cult following that remains loyal almost twenty years later.

Star Trek differed greatly from earlier science fiction television programming in that it addressed serious issues. A common theme of creator Gene Roddenberry was to transpose a current social issue such as racial tension or the status of women into the time period of Star Trek. Thinly disguised as problems of another world, these issues were confronted and satisfactorily resolved.

Star Trek was cancelled because of declining ratings and audience demographics which revealed it appealed to mainly children and teenagers.

After its cancellation though, Star Trek's adult audience began a nationwide petition drive to revive Star Trek.

The show returned to television from 1973-75 as an animated series on Saturday mornings.



More than anything, students like to watch a good phaser battle.

Photo by Kurt Worrell

"I just think so many people grew up with Star Trek that it has a following."

Locally, Star Trek is shown every Sunday night at 11 p.m. on WISC-TV, channel 3. According to Jill Kane, programming director, this is the fifth year for Star Trek on Madison television.

Previously, Star Trek was shown on Saturday nights. It had a 46 percent share of the audience in that position but it is now capturing up to 62 percent of the audience on Sunday nights. In fact, results of the July Arbitron survey placed Star Trek ahead of the Olympic coverage.

Kane offered several possibilities for Star Trek's tremendous popularity. She said, "The recent (Star Trek) movies have helped a lot . . . they add to its appeal.

Kane added, "I just think so many people grew up with Star Trek that it has a following."

The Star Trek phenomena is not limited to television and movies, however. A spokesperson for B. Dalton Bookseller in the University Square stated that a new Star Trek novel appears almost every month and they appear to be steady sellers.

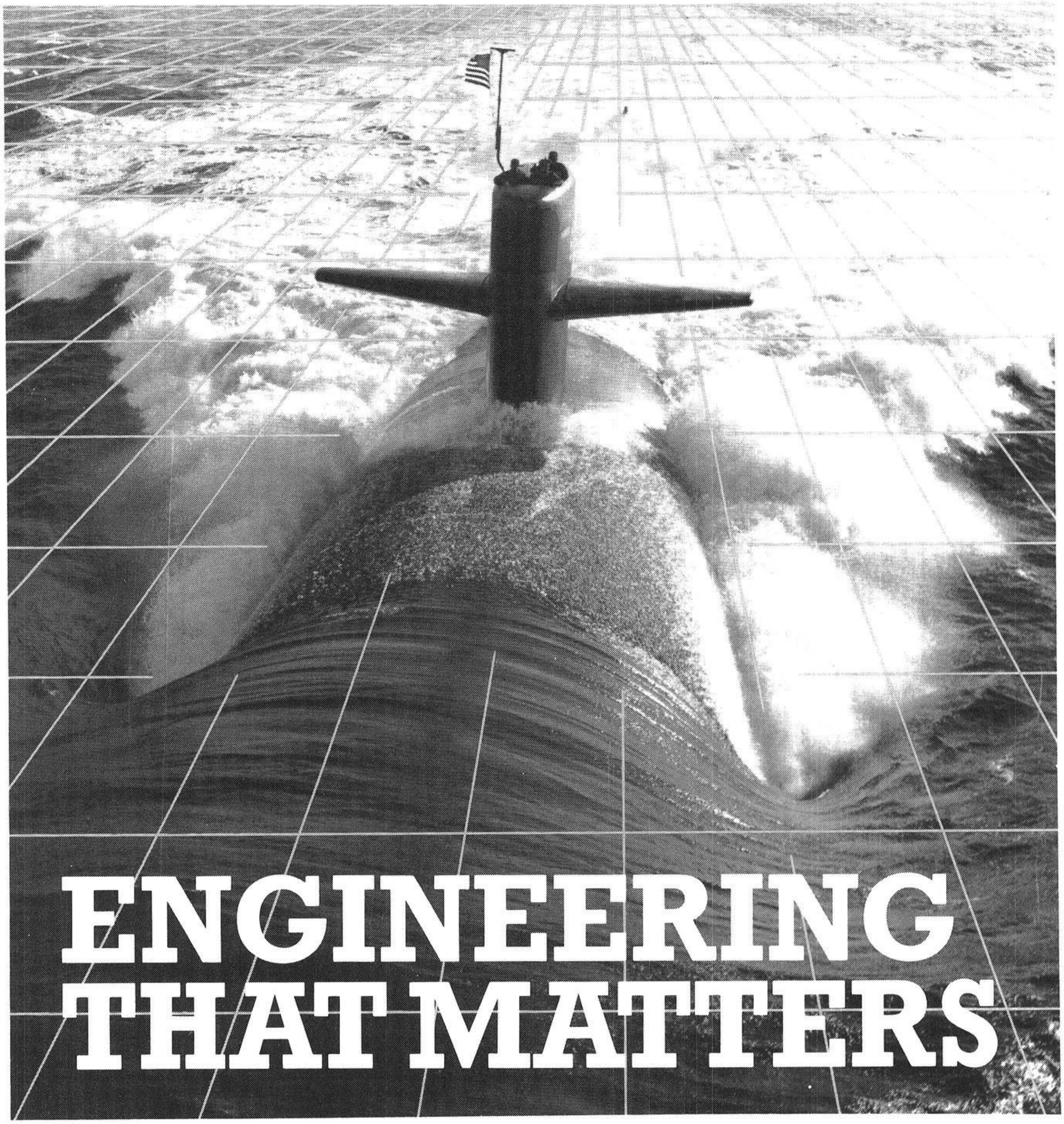
"They seem to be a very popular item in Madison," he said.

The popularity of Star Trek is so University-wide that the Ant Bridge, a student political party, made Sunday night Star Trek parties at Memorial Union a campaign promise.

"Everyone sits around and laughs at Kirk and has fun."

According to Avram Rosen, co-president of the Wisconsin Student Association, the possibility of Star Trek parties still exists.

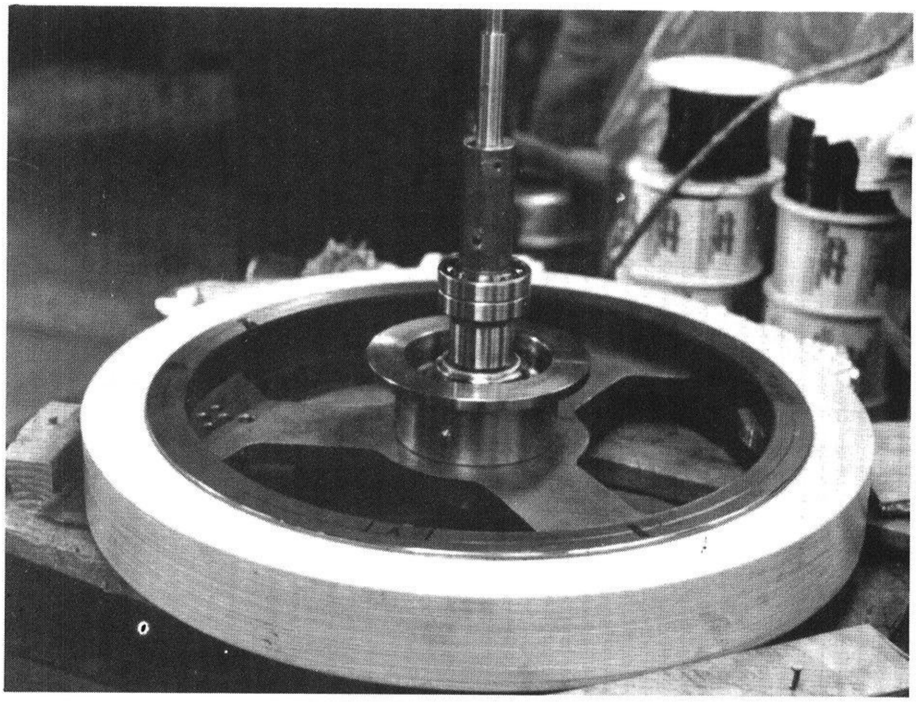
Rosen commented, "It's a great way to get together with your friends before the week starts. (Everyone sits around and laughs at Kirk and has fun.") □


ENGINEERING
THAT MATTERS

Flywheels For Your Ford

Flywheel research may result in a new generation of automotive technology.

By Jim Rossmiller



Professor Frank's flywheel energy storage system may prove very useful in automotive systems.

In 1971, Professor Andrew Frank began research aimed at providing improved fuel efficiency in transportation. This research is going to provide some interesting improvements in your daily life. Consider having a more powerful automobile combined with half the fuel consumption. "Impossible", you say. That's what General Motors said when they were first approached by Prof. Frank.

When the design group headed by Prof. Frank first considered improving fuel efficiency in an automobile, they identified three major savings opportunities. First, the internal combustion engine is most efficient when operating at a peak load. For city driving, a car requires about 10 horsepower from the engine. Outside of the city, about 100 horsepower is required. Significant fuel savings can be achieved by operating the engine at it's peak efficiency, or not at all. A second savings opportunity was recognized in the fact that the engine idles at stop lights. The fuel burned while at a stoplight is wasted. Efficiency can be improved by saving the energy generated by the engine, or by not running the engine, when the car is stopped. Decelaration is a third savings opportunity. The energy dissipated while decelerating is lost in the form of heat in the brakes. This energy could be used to recharge a system. It is clear, city driving is not a very efficient use of an automobile engine.

When asked what were some of the major problems in developing flywheel systems, Professor Frank answered, "Funding."

Prof. Frank's research identified three ways to take advantage of these energy savings opportunities. The first was an electric hybrid system. This system utilized an internal combustion engine, an electric motor, and batteries. In 1971, an experimental model was built and found to be too inefficient to warrant further study at this time. A second method investigated was the hydraulic accumulator system. This system stores energy in the form of compressed air. The advantages of the hydraulic accumulator is that it is efficient. The major disadvantage is that it is too large for use in passenger cars. Buses and trucks are being considered for this system. The third system of energy storage considered was the flywheel system. The energy in this system is stored in a flywheel which rotates at very high speeds. The flywheel system is slightly less efficient than the hydralic accumulator system, but the flywheel has the advantage of being relatively compact. Because it is efficient and compact, Prof. Frank decided to direct attention to the flywheel system.

The flywheel system is composed of three major components. The engine drives the flywheel which in turn drives the transmission. The flywheel is made up of steel and a graphite, Keylar, and glass composite. The rotational speed of the flywheel is between thirty and fifty thousand RPM. A flywheel on a present day car rotates between one and six thousand RPM. In this system the engine runs only at it's peak operating efficiency. Flywheel cars will still require large horsepower engines to haul them up mountains. This does not pose a significant problem because large engines operate at efficiencies which are at least as high as smaller engines. The heart of the flywheel system is the continuously variable transmission. This transmission can be thought of in terms of a conventional automatic transmission. The continuously variable transmission has a high gear ratio a low gear ratio and an infinite number of gear ratios in between. Because the engine operates at one speed, another method of controlling the speed of the automobile is required by the flywheel system. A conventional transmission car has it's speed controlled by controlling the carburator. The flywheel system car has it's speed controlled by controlling the transmission's gear ratio.

When asked what were some of the major problems in developing the flywheel system, Prof. Frank answered, "Funding." GM simply did not believe that a twofold increase in fuel economy could be reached by this project. They now have fifty people working on a flywheel project of their own. Original funding was provided by the Department of Energy. Just as parts were being brought together to build a flywheel car the Department of Energy cut all funding for the project. Funding is now provided by a Toyota related company. A flywheel Pinto was built in 1976 and a Pontiac Phoenix is very near completion.

Operating a flywheel at high speeds and in a vacuum caused many complex technical hurdles. Originally the flywheel was made of steel. The possibility of catastrophic failure caused Prof. Frank to seek out new materials and configurations for the flywheel. The Federal Government had a flywheel program in the 1970's. This program spent around $100 million researching flywheels. One of the goals of the Government program was to produce a flywheel made completely of a composite material. This proved to be a Herculean task so the program was tabled. Instead of taking one large step towards an all composite flywheel, Prof. Frank decided to take small steps. This philosophy led to the use of the steel and composite flywheel. The steel provides the stability and stores over 60% of the energy. The composite, which is under low stress, protects the steel from catastrophic failure.

There are certain dangers which are inherent in storing energy. These dangers are not proving difficult to handle with the flywheel system. (An early concern was what effect would the flywheel, acting as a gyroscope, have on the stability and safety of the car.) These fears are proving to be over emphasized. During an accident, the flywheel might be dangerous if it is not decoupled. Methods for decoupling the wheel during an accident are being worked on. As a matter of course, passengers will be well guarded from the flywheel at all times.

Besides applying the flywheel to passenger cars, there are some other interesting applications which are under consideration by Prof. Frank. A flywheel system in an army tank would not only provide a more energy efficient machine but it would be a silent machine as well. When munitions are handled, internal combustion and electric motors are dangerous to use. There is a proposal to handle munitions by flywheel powered vehicles. These vehicles would have a charging station, possibly an electric motor, outside of the dangerous area. After being charged the flywheel vehicles could perform their functions until another charging was needed. An offshoot of this proposal is the possibility of using flywheel-powered forklifts in factories. By lowering or eliminating exhaust emissions from forklifts, less outside air would be needed in the plant. This could significantly lower heating bills. The no exhaust capability of high powered flywheel forklifts would allow it to be used in food handling as well as clean rooms like those used in the manufacture of computers.

The continuously variable transmission car should be on your showroom floor in 1986.

The next question is, "When can I get one?". The heart of the system, the continuously variable transmission was originally slated to be in production in 1985. Most of the major transmission manufacturers are still considering the durability, and manufacturability of this type of transmission. Problems such as these are not insurmountable in this case. (The continuously variable transmission car should be on your showroom floor in 1986.) This transmission is critical to the flywheel system car, but once it is produced a flywheel powered car will follow shortly. In about 1990 look for a flywheel powered car silently speeding down your street. □

To Be Or Not To Be

Some inventions whose time could come.

By Jeaneen Haley

In this fast-paced world of high technology, it seems the creative ideas of common man are swept under the rug of time, and then forgotten. So I took to the streets in order to question individuals on ideas they think should be invented. Of course I couldn't write down all the wonderful ideas, but here are some of the more noteworthy ones.

As a matter of convience I have divided these 'inventions' into three catagories: I. Creative; II. Improbable But Neat; III. Truely Practical.

I. Creative

Silent flush toilets—(no one will ever know what you do or when you do it.)
Alcohol ice-cubes—(for the never watered-down drink.)
Clear Kool-Aid—(fool friends and neighbors.)
Memory drug—(something we all could use.)

II. Improbable But Neat

Radio-active undies—(makes great Christmas gifts for your enemies.)
Anti-drunk pills—(a must for the college student.)
Lecture seat lifts—(avoid climbing over rows of people.)
Sore throat bags—(a soothing sac which rests in your throat.)
Handcuffs for your trees—(a must for those hard to manage trees. Only $5.00 from Robco.)

III. Truly Practical

Spray-on sunglasses—(in an aerosol can.)
Pocket dictatable word processor—(does everything but drive you to work.)
Degree-calibrated shower head—(you'll never be scalded again.)
Portable dust collector—(just like fly-paper for dust.)
Snot proof tissues—(finally a tissue that doesn't disintegrate.)

None of these one of a kind inventions has yet been patented, but that is not to say that they don't have potential. Only time will tell if these inventions are **to be or not to be**. □

Real Computer Scientists Don't Write Code

Author Unknown

Real computer scientists don't write code. They occasionally tinker with "programming systems," but those are so high level that they hardly count and rarely count accurately. (Precision is for applications.)

Real computer scientists don't comment their code. The identifiers are so long they can't afford the disk space.

Real computer scientists don't write the user interfaces; they merely argue over what they should look like.

Real computer scientists don't eat quiche. They shun Szechwan food since the hackers discovered it. Many real computer scientists consider eating an implementation detail. (Others break down and eat with hackers, but only if they can have ice cream for dessert.)

If it doesn't have a programming environment complete with an interactive debugger, structure editor, and extensive cross-module type checking, real computer scientists won't be seen tinkering with it. They may have to use it to balance their checkbooks, as their own systems can't.

Real computer scientists don't program in assembler. They don't write in anything less portable than a Number Two pencil.

Real computer scientists don't debug programs; they dynamically modify them. This is safer, since no one has invented a way to do anything dynamic in FORTRAN, COBOL, or BASIC.

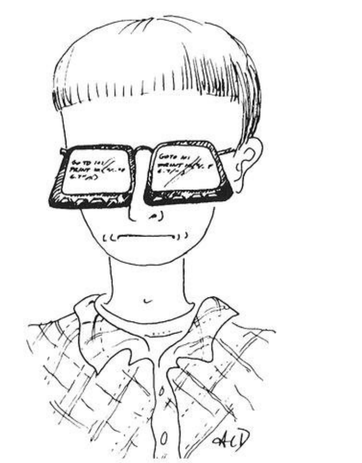
Real computer scientists like C's structured constructs, but they are suspicious of it because it is compiled. (Only batch freaks and efficiency weirdos bother with compilers; they're sooo un-dynamic.)

Real computer scientists play Go. They have nothing against the concept of mountain climbing, but the actual climbing is an implementation detail best left to programmers.

Real computer scientists admire ADA for its overwhelming aesthetic value, but they find it difficult to actually program in, as it is much too large to implement. Most computer scientists don't notice this because they are still arguing over what else to add to ADA.

Real computer scientists work from 5 pm to 9 am because that's the only time they can get the 8 megabytes of main memory they need to edit specs. (Real works starts around 2 am when enough MIPS are free for their dynamic systems.) Real computer scientists find it hard to share 3081s when they are doing "real" work.

Real computer scientists only write specs for languages that might run on future hardware. Nobody trusts them to write specs for anything homo sapiens will ever be able to fit on a single plant. □



Graphic by Alicia Diehl

EXPO 85: A Super Opportunity For You

By Fai Chau Hon

The biennial Engineering Exposition, EXPO 85, will be held on April 12 to 14. Since 1940, this exposition has been one of the most important and largest events in Madison and in the mid-west. During the past year and a half, students have spent a lot of time preparing for this exposition. Now, only 4 months are left, and the final preparation is going to start. This exposition needs your support.

The title of this year's exposition is "Engineering: meeting the challenges of tomorrow." The main purposes of the EXPO 85 are: to acquaint the general public with the engineering profession through industrial, government, and student exhibits; to inform the public of new developments in engineering and technology; to expose high school students to the various aspects of the different engineering fields.

This time the EXPO 85 has a special guest—Bell Laboratories. Besides our special guest, IBM, Digital Equipment Corp., GM, 3M, McDonell Douglas, and many other companies will be participating in the exposition. According to the information we have now, IBM will bring their successful personal computer family to the exposition; GM will show their recent models of car and a film of robotization in car making. However, we still have no idea about what fancy technologies Bell Labs will have to show.

Besides exhibitions from industries, student projects are a key part of the exposition also. The committee of the EXPO expects that this year 150 to 200 student projects will be received, but as of this moment, only 20 project applications or registrations have been received. So if you are interested in showing your bright ideas to the public, go and talk with the committee. You will find out where you can get financial support and resources from our university and outside companies. Students who decide to participate in EXPO 85 can earn 3 credits from Independent Study 699.

As the co-chairman of EXPO 85, Sue Guzman, put it, "EXPO is a good chance to work with people inside and outside our university. Furthermore, it provides an environment to build and improve your skills in organizing and communication." EXPO 85 needs the support from you; go and show your excellent ideas! □

The Equilibrium Solution

Rapid, reliable methods for solving chemical equilibrium equations have long been sought by scientists asking fundamental questions about systems as varied as the atmosphere, the human body, and the internal combustion engine. An interdisciplinary collaboration at the General Motors Research Laboratories has produced a breakthrough with potentially universal applications.

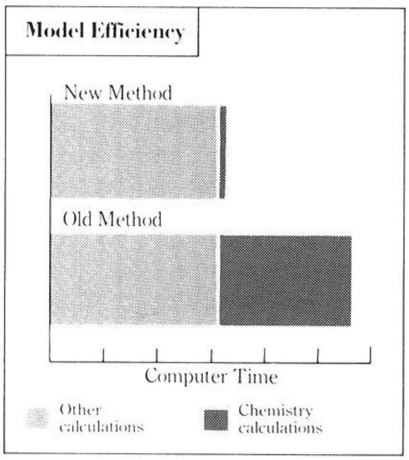
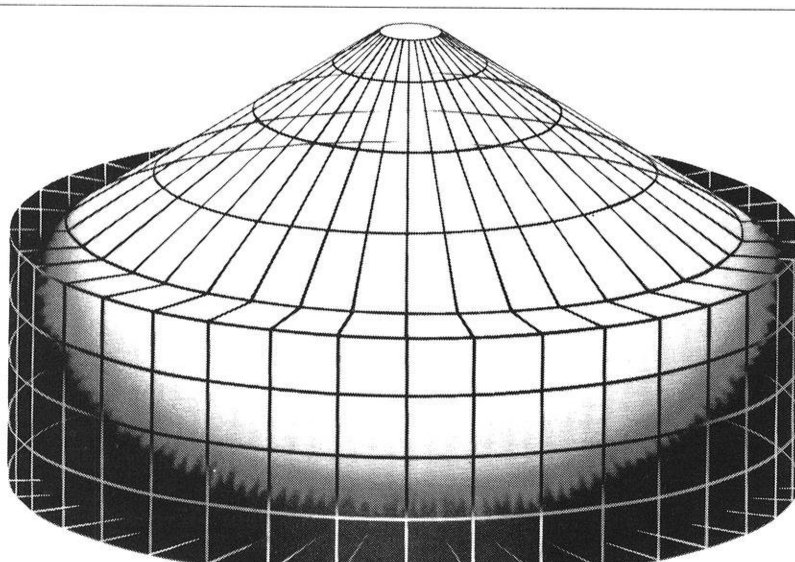


Figure 1: Computer time required by an engine combustion model. Time required for chemical calculations decreased greatly with the new methodology.

Figure 2: Artist's illustration of a chemically reacting flow. The physical space is divided by a latticed network into units of volume, and the solution must be recalculated for each grid point at each instant of time.



WHEREVER CHEMISTRY is involved, the need to solve chemical equilibrium equations arises. Although methods for solving such equations have existed for some time, they do not offer the speed demanded by the most challenging problems. For example, predicting the composition of gases inside an engine cylinder may require as many as a million equilibrium calculations per cycle. Two researchers at the General Motors Research Laboratories have developed a systematic way to reduce the mathematical complexity in these problems, thus making it possible to solve them rapidly.

Chemical equilibrium occurs when the rates of a forward and reverse reaction are equal. Mathematically, this statement usually translates into a system of nonlinear polynominal equations. Until now, there has been no fast reliable method for solving such systems. Solutions to particular problems have demanded thorough familiarity with the physical conditions. In most cases, this means partial knowledge of the answer.

Dr. Keith Meintjes of the Fluid Mechanics Department and Dr. Alexander Morgan of the Mathematics Department began their research by considering recent advances in the theory of continuation methods. They concluded that a suitable continuation algorithm could be relied on to solve the nonlinear polynomial equations that make up chemical equilibrium systems. In this insight lies the realization that the solution can be obtained without any knowledge of the physical nature of the problem.

In seeking the most efficient implementation of the continuation method, the researchers discovered that chemical equilibrium equations can always be systematically reduced to a substantially simpler mathematical form. The reduced systems have fewer unknowns and a smaller total degree. The total degree of any system is the product of the degrees of each of its equations. Reducing the total degree makes a system easier to solve. A typical combustion problem with ten equations and total degree of 192 was reduced by the researchers to two cubic equations with a total degree of nine.

The reduced systems can then be systematically scaled to fit within the limits imposed by computer arithmetic. The range of coefficients in chemical equilibrium systems tends to be too large or too small for the arithmetic of the computer. Consequently, the solution process can fail. By construction of an effective scaling algorithm, this arithmetic constraint can be eliminated. Suitably reduced and scaled, the equilibrium systems can then be solved reliably by the continuation method.

THUS, Drs. Meintjes and Morgan accomplished their original goal of developing an innovative reliable approach to solving chemical equilibrium equations. They also made a final, unexpected discovery. Certain standard solution techniques, which fail on the original systems, can be made absolutely reliable when applied to the reduced and scaled systems. These methods, which are variants of Newton's method, are also many times faster than continuation.

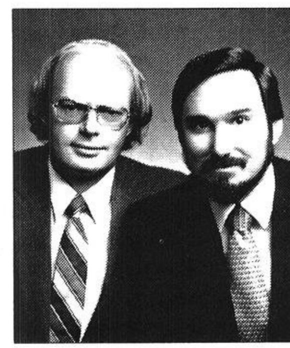
This research has produced an extremely effective solution strategy—reduction of the equations, followed by scaling of the reduced systems, followed by the application of a suitable variant of Newton's method. The simplification of the systems, which was originally formulated to facilitate the implementation of the continuation method, proved to be the critical factor enabling the use of fast techniques.

In one application, the chemical equilibrium calculations are part of a model which predicts details of the flow, turbulence, and combustion processes inside an engine. By using their methodology to develop an equilibrium solver for this application, the researchers greatly increased the model's solution efficiency (see Figure 1).

"It was the characteristic structure of equilibrium equations," says Dr. Meintjes, "that allowed us to perform the reduction. The unexpected mathematical simplicity of the reduced systems suggests that even more efficient solution methods may be discovered."

"Critical to this research," says Dr. Morgan, "was the dialogue between disciplines. I hope that this dialogue will continue as scientists and engineers in diverse fields explore the capabilities of this new methodology."

THE MEN BEHIND THE WORK



Dr. Keith Meintjes, a Staff Research Engineer in the Fluid Mechanics Department, joined the General Motors Research Laboratories in 1980. Dr. Alexander Morgan, a Staff Research Scientist in the Mathematics Department, joined the Corporation in 1978.

Dr. Meintjes (left) was born in South Africa. He attended the University of Witwatersand, where he received a B.Sc. and M.Sc. From 1973 to 1975, he taught fluid mechanics and engineering design at the university. He then went on to study at Princeton University, where he received an M.A. and Ph.D. in engineering. His doctoral thesis concerned numerical methods for calculating compressible gas flow.

Dr. Morgan (right) received his graduate degrees from Yale University in differential topology. His Ph.D. thesis concerned the geometry of differential manifolds. Prior to joining General Motors, he taught mathematics at the University of Miami. His book, "Applications of the Continuation Method to Scientific and Engineering Problems," will soon be published by Prentice-Hall.

Contest Winner: First Place

The Normal Person's Job-Getting Guide

Some realistic suggestions for landing that first job.

By John Koch

Looking for a job is not only hard work, it is stressful, demeaning, and unknown to any other mammalian species on earth. It should be avoided if at all possible.

If you've decided that you must look for a job, you will get no help from other articles, because they are written for those aggressive and capable individuals who are already making a good living selling **GRIT** door-to-door. This article is different. This article is for you.

How can a dull person like me find an interesting job?

First, this article must clear up a misconception. "Interesting job" is a contradiction in terms, like "kosher ham-and-cheese-on-rye" or "non-partisan judiciary." There is no such thing.

What people usually think of as "interesting jobs" are actually "dangerous jobs." These are jobs like astronaut, movie star, steeplejack, whale harpooner, goalie for the Toronto Maple Leafs, and Pope. These jobs usually require physical coordination, disregard for personal safety, and the ability to say the name of God in more than one language. This manual strongly recommends that you do not apply for a dangerous job.

What people usually think of as "interesting jobs" are actually "dangerous jobs."

How should I prepare myself for job hunting?

Other articles will tell you to first candidly assess your strengths and weaknesses. Don't. It can only depress you to the point that you think about going to graduate school.

There is only one way to prepare yourself for job hunting. Set aside a day when you will be entirely free from interruptions. Get up at 5:30 a.m. and have a good breakfast, including plenty of roughage. Turn on the television at 6 o'clock and watch it until midnight. Do not change channels. Do not leave the room unless absolutely necessary. Watch everything carefully, critically, and without letting your attention wander: drama, comedy, news, commercials, soap operas, etc.

Television is about a three trillion dollar industry in this country. People who work in television have suntans all year round, get invited to good parties, and are paid well enough to buy **GRIT** from those aggressive and capable individuals who sell it door-to-door.

After watching eighteen hours of television, would you trust any of them to teach a goldfish to swim?

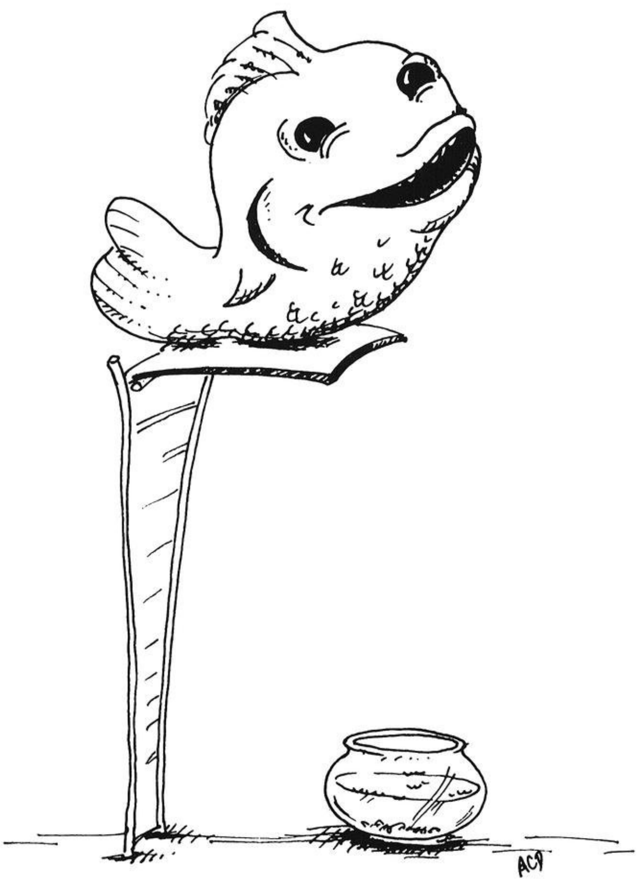
You are now ready to go job hunting.

Do I need a resume?

Yes, because it guarantees that the person who does the hiring will have your Social Security number before you even appear for the interview. Many personnel managers will tell you that failure to produce a Social Security number is the single most common reason they have rejected job applicants. Billy Martin might be managing the Milwaukee Brewers today if his wallet hadn't been in another room when Harry Dalton called.

How should I dress for an interview?

In these fitness-conscious times, a clean, pressed pair of jogging shorts, plus a t-shirt advertising a top-quality brand of shoes, is suitable for interviews in the financial, academic, and computer fields, as well as Octopus car



Graphic by Alicia Diehl

washes and the stuffier segments of the media. Softball uniforms are no longer acceptable (at least for men), unless you are applying for a job on a softball team. The sports industry is an exception to the rule that the way you dress for an interview should be entirely different from the way you expect to dress for the job. But then the sports industry has also given us the phrase "free-agent draft" — another contradiction in terms.

In general, though, the rule holds good. For example, the clothes worn by Prime Minister Margaret Thatcher of the United Kingdom are a good example of what a woman should wear when applying for a job washing camels in a circus; few people know, however, that Mrs. Thatcher was chosen as leader of the Conservation Party while wearing a t-shirt that said, "I CLOSED THE HOUND AND FLOUNDER, LIVERPOOL."

What should I say during a job interview?

Imagine for a moment that you are a typical personnel manager, Mr. Nosferatu. Mr. Nosferatu spends most of each workday listening to other people talk about themselves, their education, their experience, their plans, their cousin Buck who used to be able to balance a watermelon on his forehead, and their hobbies. Maybe Mr. Norferatu would like to talk about something he's interested in for a change.

When you are ushered into the office, the very first words out of your mouth should be "Seen any good movies lately, Mr. Nosferatu?" (Providing, of course, that you are talking to Mr. Nosferatu; use the last name that seems appropriate.) Also ask about books, pets, houseplants, zoos, restaurants, interest rates, dietary roughage, and the enduring influence of Talleyrand on the map of Europe. Ignore any attempt to turn the conversation to you and your pathetically unrealistic desire that the company your interviewer represents might pay you money that could be better invested in a mated pair of mongooses to be loosed during union meetings.

Try to maintain any rapport that develops between you and the interviewer without letting it get out of hand. Specifically, you should not let the interviewer talk about his or her marriage, children, sexual hang-ups, or rivals in the company. Such revelations are a sure sign that the interviewer never expects to see you again. If at any time your interviewer seems ready to weep, quickly turn the conversation to the industrial melanism of **Biston betularia** as evidence for evolution, which, if your interviewer is like most people, is the only thing that he or she remembers from college.

What questions should I ask about the company?

Ask about the food in the cafeteria. This is something that is not mentioned in **Standard & Poor's** or the annual reports, and therefore does not give away the fact that you don't know whether the company makes computers or toad repellent. (Your interviewer is probably hazy on this point himself, anyway.) In addition, the thought of cafeteria food, good or bad, is likely to make blood rush to the interviewer's digestive tract where, on the whole, it can do you less harm than in the cerebral cortex.

You should not let the interviewer talk about his or her marriage, children, sexual hang-ups, or rivals in the company. Such revelations are a sure sign that the interviewer never expects to see you again.

Graphic by Alicia Diehl

What if I am interviewed by more than one person?

The team approach to interviewing was pioneered by the Spanish Inquisition, though the use of pincers and molten lead has been all but abandoned by **Fortune 500** companies today. No matter the number of interviewers, each will be readily indentifiable as Mr. Nice-Guy or Mr. Tough-Guy.

This can be deceptive, particularly if a Mr. Nice-Guy meets you at the door with a glass of milk and a big plate of hot oatmeal cookies. Remember that Mr. Nice-Guy is secretly ashamed of not being tough, and vice versa. Your best bet, therefore, is to give all your attention to Mr. Tough-Guy, asking him (or her, of course) about movies, books, zoos, houseplants, etc., while answering any remark from Mr. Nice-Guy with a surly sneer and a crack about the Japanese making better cookies at half the cost.

Should I send a thank-you letter to the interviewer?

The mail rooms of most large corporations today are staffed by English and comparative literature Ph.D.'s who read those other articles about job hunting. To amuse themselves, they re-write all non-essential mail into the form of triolets, eight-line verses with the rhyme scheme ABaAabAB, and in which the first line is repeated as the fourth and seventh, and the second as the last.

Needless to say, a thank-you letter from you reading:

Thank you much for the interview,
Mr. Andrew Wellington Gratz,
That you gave me Tuesday at half-past two.
Thank you much for the interview;
You had more interesting things to do,
Like feed your bushes and prune your cats.
Thank you much for the interview,
Mr. Andrew Wellington Gratz!

is likely to work against your employment prospects, particularly if your interviewer's name was Hildegarde Sweeney, and the mail room simply used "Andrew Wellington Gratz" for the scansion and rhyme scheme. Moreover such letters are easily confused with Federal Trade Commission regulations, which are routinely re-written into sonnets.

It is better to say thank you in person, preferably at a restaurant or movie theater you have unobtrusively followed your interviewer to. These are places where he or she is likely to be congenial and least likely to shout. Even if you do not get the job you applied for, a sincere "Thank you!" spoken in the middle of a good movie or a good dinner is likely to lead your interviewer to suggest several competing firms you can apply to. □

Flexible Manufacturing Systems Can Cut Costs

By Hassan Syed

In recent years the American manufacturing industry has been faced with new challenges. Some of the challenges have come in the form of competition from abroad and consumer demand for competitively priced, high quality customized products. Forced by other market factors, such as shorter product life cycles, manufacturers are turning to production systems that give them the lower costs and flexibility they need to compete successfully in today's market. One such system is known as a Flexible Manufacturing System (FMS). Flexible manufacturing systems can be described as banks of different kinds of direct numerical control machines and related equipment brought together to completely process a group of parts. An FMS is generally made up of direct numerical control machines, a material handling system, and a supervisory computer control network.

The second largest controllable expense of many manufacturers is their work in progress inventory.

The work stations usually consist of numerically controlled (NC) machines, but could also include inspection, load/unload, and assembly stations. The centralized computer system controls and monitors the overall system. The computer system is responsible for scheduling the release of orders and for controlling part flow. It is also responsible for the traffic flow through the materials handling system, and part processing through NC programs. Finally, it also monitors the overall system. The parts are released into the system according to a master plan directed by an on-line minicomputer that is connected to the main computer. The parts are carried on pallets to their specific work stations by an automated material handling system. After completion, the parts are carried out by the material handling system to an unload station.

There are certain conditions that determine when it is probably a good idea to use a FMS production arrangement:

1) When production volume is in excess of two parts per hour.
2) When more than five machines are required.
3) When processing requires more than two machine types to complete a piece.
4) When phased implementation is planned.

There are three main benefits that can be derived from using flexible manufacturing systems:

1) Increased production flexibility in terms of product design or production volume.
2) Reduced operating costs.
3) Improved ability to respond to the market and its unpredictable demand characteristics.

A FMS used with proper control systems gives its users immense capabilities in terms of production and operations management. To users, the flexibility of an FMS is its major attraction. If a machine goes down there is no problem — parts may be rerouted through another machining center in the system. If a design change is required, it can be handled easily by versatile multiply tooled machines.

The flexibility of the FMS provides its users with a major competitive weapon in the market.

Flexible manufacturing systems have been shown to produce quality products at low costs through enhanced productivity. One major savings comes from the reduced set up time for machining operations. Multiple tooling of the machines avoides the need (to change fixtures) for separate machining operations. This capability provides faster processing, hence lower cost, of the parts produced in the system.

(continued on page 17)

Robotized production systems such as this may give manufacturers added flexibility in their factories.

WILD LIFE

By John Kovalic

Solar Research Group Explores Energy Options

The solar lab team continues its R&D work in solar energy systems.

By Monica Sund

Some forecasters predict that by the year 2000 the world's oil and natural gas supplies will be depleted. This sounds scary, considering our whole economy is based on these dwindling energy sources. To alleviate our fears, experts predict our coal supply will last several centuries. What experts don't tell us is that coal use contaminates two other precious commodities, namely, air and water. When coal combusts it produces toxic air pollutants. When coal is transformed into other useable energy forms it requires large amounts of water. If we continue using our current energy technology, eventually we will either deplete our present energy sources or contaminate our environment to intolerable levels. Because of this dilemma there is increased activity in the energy field, specifically in areas that might improve efficiencies of present energy technology or develop alternative energy sources. A considerable amount of research has been done on renewable energy sources such as wind and solar energy. Professor J.W. Mitchell foresees the energy of the future to be solar. Professor Mitchell is intimately involved with the University of Wisconsin-Madison Solar Lab group. The Solar Lab group includes professors Klein, Duffie, Beckman and 15 students. This group researches various

Some forecasters predict that by the year 2000 the world's oil and natural gas supplies will be depleted.

solar innovations and also consults with organizations that would like to conserve on their energy use. Madison Gas & Electric Company (MG&E) is also involved in projects that utilize renewable energy sources. This article will describe some of the projects that are currently being examined for their energy potential by the Solar Lab group and MG&E.

Solar desiccant air conditioning is one of the Solar Lab group's main areas of research. This system is used for controlling the interior environment of buildings. A desiccant is a drying agent such as a silica gel. This drying agent is a dehumidifier which takes moisture out of the air. The moisture must be taken out of the air otherwise this moisture would condense on the equipment, causing damage. Also, the drier air makes for more comfortable environment. Solar panels are used as a high temperature heat source for drying the desiccant so that it may be reused. With the present cost of energy, the use of solar energy is not cost effective. Rather, the use of the hot exhaust from the air conditioner is a better alternative for drying the desiccant. The primary reason why solar energy is not cost effective for this is because very high temperatures are required to evaporate the moisture-laden desiccant.

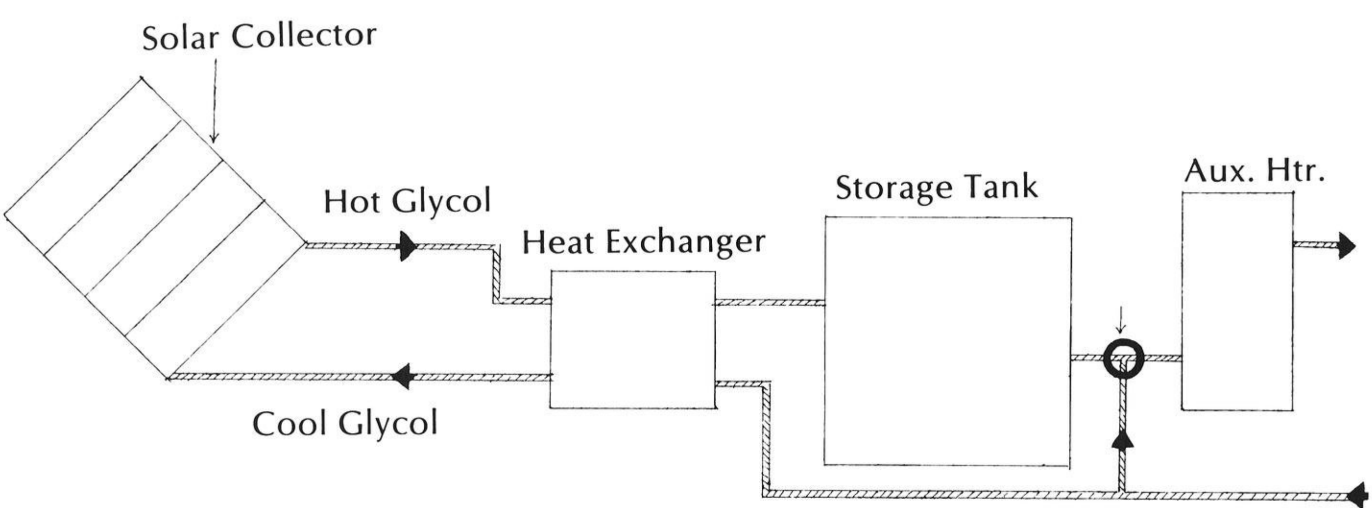


Fig. 1 Diagram of solar water heating with auxiliary system operation.

Graphic by John Tucker

Some other ideas being researched by the Solar Lab group are various coatngs and glazes. One type of space heating project is to apply a dark coating on he exterior of a south facing wall of a residence. An air space is left between the outside and the inside walls. At the top of the wall are one way directional vents to allow the heated, lighter air to rise and enter the room. This type of project seems to be cost effective. Another idea that increases the thermal resistance (insultative effects) of windows is to fill the air space between window panes with an arrow gel. This gel has tiny bubbles in it that give the appearance of a frosted window pane. This type of glazing allows the interior space to be heated by the sun's rays but decreases the heat flow out of the room. Windows with the arrow gell have a thermal resistance like that of a wall.

Madison Gas & Electric Company has undertaken many innovative energy conservation projects. One of their current projects is solar heated water. The system used for water heating is essentially the same as that used for space heating. The operation of the system (fig. 1) consists of solar collectors placed on the roof of the building. A typical fluid used in the collectors for heat absorption is glycol. Water is not used because it would freeze in the winter. The heated glycol is then passed through a heat exchanger when heat is transferred to water (or air if space heating is required.) The heated water flows to a storage tank and the cooled glycol flows back to the collector to be reheated. The hot water is pumped to a storage tank to be used on cloudy days or as a ready supply for fluctuating daily needs. Water from the storage tank is delivered to a conventional auxiliary water heater, but before reaching the heater the water passes through a tempering valve which is heat sensitive. If the water is too hot, cold water is added. If the water is not warm enough, the auxiliary heater will bring it up to the required temperature. The solar heating system can be thought of as a preheat for the conventional water heating system. Solar energy systems are

As conventional fuel prices keep climbing, the more expensive alternate energy forms will become more attractive.

almost always installed with conventional units as a backup in case the solar unit is unable to meet the energy demands. It is economically reasonable to install conventional heaters in solar energy systems as well. A conventional heating unit has small equipment costs when compared to the equipment costs of a solar energy unit. On the other hand the fuel costs associated with the conventional system are large while the fuel costs for the solar energy systems are nonexistent. The percentage of energy contributed by the solar energy system was estimated to be 82% for this project. (Presently, MG&E is analyzing the project to determine the actual contribution by solar sources.) By using solar energy, fuel costs should be substantially reduced. This type of solar heated water system is cost effective when compared to conventional systems using electricity, oil, or LP gas at current prices. It is also cost effective when compared to natural gas if tax credits and rebates are included. The energy contribution of the solar energy system depends on location and the cost effectiveness depends on the current level of fuel prices.

At the present time our interest in developing alternate energy sources and conservation techniques is purely economic. High fuel prices have spurred research in the energy field to find ways to cut fuel costs, either by reducing fuel consumption or finding less expensive energy alternatives. As conventional fuel prices keep climbing, the more expensive alternate energy forms will become more attractive. More energy projects, like the ones discussed here, that are not cost effective now will probably become more economical. As a result, it is likely that this kind of solar technology will be commonly used in homes and by industry in the future. □

(continued from page 14)

The second largest controllable expense of many manufacturers is their work-in-process inventory. Studies have shown that during 93% of the time a work piece spends in the shop, it is not on a machine. If a work piece went directly from one machine to the next, with no waiting or transport time, there could be a 93% reduction in inventory cost, space needed for storage, and associated problems. Operating experience gained from using flexible manufacturing systems has shown that the amount of labor needed to produce a work piece can be reduced to one-fourth of previous levels.

The flexibility of an FMS gives its users a major competitive weapon in the market. The ability to make quick design changes allows the manufacturer to respond to the market quickly. It's been shown that an FMS can cut lead times by a factor of five to six times. Increased capabilities allow the acceptance of new product design with minimum cost.

To summarize, we are likely to see this kind of adaptable manufacturing system used frequently in production situations where a manufacturer can best use an FMS to his advantage. Generally, he will be able to reduce costs, and at the same time respond more rapidly to changing market demands. The net result is that he will have a sharper competitive edge in the manufacturing industry. □

Contest Winner: Tied for Third Place

Great Engineers in History

A great engineer seeks funding for an ambitious project.

By Christina Peterson

"Name?"

"God."

"Oh yes, Mr. God, Mr. Abbot is expecting you."

"It's God, just God."

"Of course."

The receptionist picked up the telephone and dialed a number. She inspected her candy-apple-red fingernails for any signs of damage.

"Yes, Mr. Abbot, Mr. God is here. Yes sir." She hung up the phone and fluttered her pewter eyelids at God.

"Mr. Abbot will see you now. Just walk right in."

Mr. God glanced at the door with the brass sign reading "Mr. Lewis Abbot, Vice-President" and walked towards it.

"God. God! C'mon in!" said the thin balding man behind the desk. "Always a pleasure to hear from our boys in the field. What's the good news?!" He motioned for God to sit down, never stirring from his own seat.

"Well, Mr. Abbot," God began confidently, "I have a proposal for you."

"Yes?" Abbot drawled, raising an eyebrow.

"I'd like to create a universe."

"What?!" Abbot coughed.

God leaned forward and placed his hands on Mr. Abbot's desk. "I'd like to create a universe."

"God," Abbot said, regaining his composure. "Do you have any idea of the cost of a project like this?"

"Yes I do, Mr. Abbot. But I'm sure once you hear my proposal you'll be as excited about this project as I am."

Barely pausing to catch his breath, God placed the briefcase he was carrying on Mr. Abbot's desk and opened it up.

"You see," he began. "This won't be any ordinary P.F.&M. Enterprise's universe. This will be an experimental universe. I propose, along with the usual stars, supernovas, planets and moons, to create life."

"Life?!" Abbot sputtered. His face was beginning to redden.

"Yes, life," God reaffirmed. "Plant life, animal life, even human life. And I propose to give them freedom of thought."

"What?!" Abbot cried, rising to his feet, positively purple. "God, this is the most outrageous thing I've ever heard in my 12 years with this company. P.F.&M. Enterprises would never consider such a preposterous plan."

"But don't you see, Mr. Abbot?" God continued. "We would be setting the trend that would shape all future endeavors and eventually provide the consultation for all future entrepeneurs."

"Have you thought at all of the consequences of creating life?" Abbot raged. "Not only life, but free-thinking human beings! Who knows what far-reaching effects this little project of yours might have. It could give our company a bad name."

"Why would anyone want a universe?"

"But consider the novelty of it, Mr. Abbot," God suggested. "You must admit this will be an attention-getter. The media coverage alone would pay for the initial set-up costs. Soon every wealthy citizen will want their own universe."

"Why would anyone want a universe?" Abbot questioned.

"Why do people spend billions of dollars every year on pets and ant farms and those little sea-monkeys from the backs of comic books? They want to play master, to have power over other living beings. Besides, it can be very entertaining."

"Hrrrmph;" Abbot sniffed. "I suppose you've bounced this off of our engineers."

"Yes sir, I have and here's what we've come up with," God reached into his briefcase and withdrew a large rolled-up blueprint. Unrolling it on Abbot's desk, he began to point out areas of interest and explain.

"Right here in Lot 4 is where we decided would be the best place for it. It's isolated from these other universes so if it does get out of hand, they won't be bothered. I already have four bids from contractors and the lowest could start construction next month." God withdrew a plastic-covered report and handed it to Mr. Abbot. "Here are the contractor's bids for the Boards use."

"Now, the best part of this universe is the added features," God continued. "Here is a star we call The Sun. It's a beautiful lemon yellow in color. About this star we have placed a solar system. One planet worthy of note in this solar system, is what we call Saturn. It has rings around it."

"Rings around it?" Abbot queried. "You don't say?"

"Now we thought we'd center our life-forms here, on this planet we call Ethel."

"Ethel?" Abbot asked.

"That's my mother's name," God blushed.

"Hmmm," Abbot mused. "Might have to do something about that one."

God continued with his plan, when finally Abbot interrupted him. "Say God," he said. "How much is all of this going to cost?"

"Our initial estimate is $145 billion; of course, that includes central air."

Abbot whistled and sat down. "I don't know how the Board is going to take this, God."

"You've got to convince them to give me a chance, sir," God pleaded. "I have faith in this project!"

"I'll do what I can, God," Abbot sighed. "But I can't guarantee anything."

"Thank you, sir," God said, closing his briefcase. "I'll leave these proposals with you to study."

God bid his boss good-bye and walked out of Mr. Abbot's office.

Abbot settled back in his chair and glanced over the materials God had left.

"I like that God." he thought. "Ambitious. Hard-working. Creative. That man's going places." □

An American Crisis

Reprinted from American Society of Civil Engineers

New York City, July 2 -- The shortage of teachers and aging facilities in American engineering schools, deteriorating infrastructure, and the growing crisis in U.S. water resources will have to be addressed if the nation is to continue to provide a high standard of living for its people, the American Society of Civil Engineers has told the Democratic Platform Committee.

In testimony before the recently concluded meeting of the Platform Committee, Albert A. Grant, chairman of ASCE's Strategic Planning Committee, urged the Democratic Party to acknowledge and consider engineering education's problems, infrastructure and water needs in its 1984 platform.

Grant, who is a former Vice President of ASCE and current Director of Transportation Planning for the Metropolitan Washington Council of Governments, Washington, D.C., said that the three problems are tied together.

The good health of engineering education is critically to the good health of the nation as a whole.

The manpower needed to tackle infrastructure and water problems must come from the nation's engineering schools. Also needed, said Grant, will be support for research into the causes of deterioration, improved ways to prevent it, and ways to finance it; for example, a national infrastructure bank, low interest loans, block grants, revenue bonds and taxation.

The American Society of Civil Engineers is very concerned with the severe shortage of teachers and the deterioration of facilities in U.S. engineering schools. "This shortage has affected the quality of instruction in these institutions (by increasing) the number of students per teacher on the undergraduate level at a time when schools are flooded with engineering students," said the ASCE official.

Antiquated physical plants, said Grant, have compounded the problem. Many laboratories are either obsolete or rapidly becoming so. Many predate World War II and use equipment from the 1950's. They have fallen behind in technology, in comparison to that being employed in government and industry.

The ASCE offical said that impact of all this is far-reaching because the good health of engineering education is critical to the good health of the nation as a whole. "For years, America has led the world in technology. Our technological prowess has enabled us to outproduce all other nations and build one of the world's highest standards of living. But now those skills are being threatened by the crisis in engineering education," Grant said.

What's more, he added, it's happening at a time when other nations are challenging American leadership in technology.

Another major ASCE concern, the country's infrastructure -- its system of roads, bridges, water and sewage systems, public transport, tunnels, canals, harbors, dams and other public facilities -- is also essential to America's economic health and standard of living, Grant said.

He noted that decades of neglect have left these facilities in critical need of maintenance and repair, particularly in older urban areas. And in newer, expanding communities, he said, existing facilities are proving inadequate. "While this does not mean that the nation's capital plant is in danger of imminent collapse, it does mean that further deterioration will threaten the nation's economic health," he said.

Grant asserted that tightened budgets and inflation have postponed repairs and cancelled upgrading to the point where the quality of life of every American is adversely affected. "Almost daily, civil engineers in federal, state and local government positions find themselves dealing with breakdowns. They are often powerless to do anything more than 'paste and patch' because they have neither the funds nor the manpower to do the job," he said.

Grant noted that although the problem is acute, the nation is spending far less on its capital plant today than it did 20 years ago. "From $33.7 billion in 1965 to less than $24 billion in 1980, our capital investment as a percent of Gross National Product has dropped from 3.6% to less than 1.7%, a 54% decline."

Civil engineer's in government positions frequently find themselves with neither the funds or the manpower to make needed repairs.

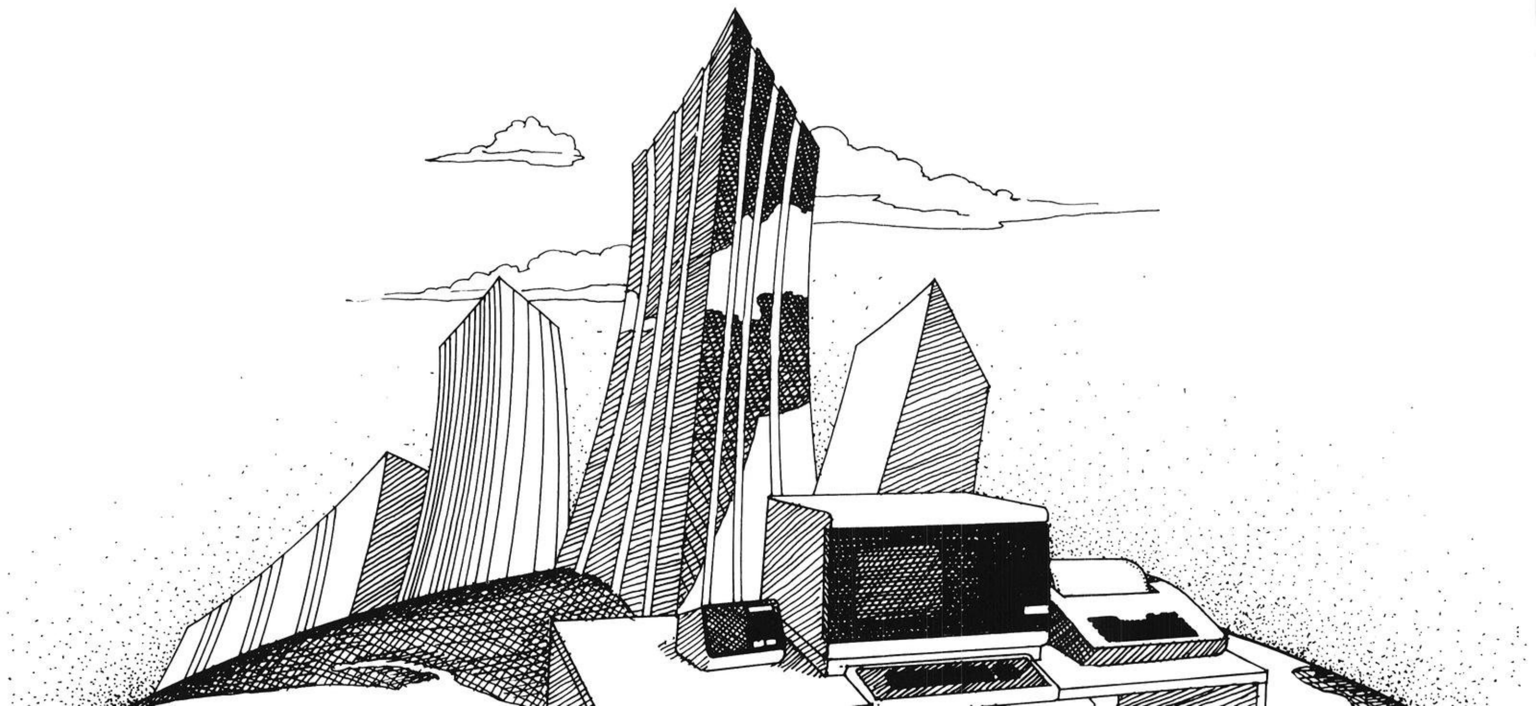
While this is happening, the Federal government has been turning over an ever increasing share of its programs to state and local governments, said the ASCE official.

A key element of our infrastructure, our water supplies, may be reaching crisis proportions, Grant said.

Older water systems are in bad shape due to age and a lack of maintenance. Intrusion of wastes, salt, chemical and other dangerous substances into the soil and groundwater supplies have added considerably to the problem. "In many parts of the country, depletion of major aquifers due to well drawdown for industry and irrigation combined with rapidly growing demand in low-rainfall areas of the West and Southwest also point to a growing water crisis," said Grant.

He noted that a recent study by the Congressional Budget Office found that many of the nation's 1,500 wastewater treatment systems are characterized by inadequate sewer pipes and sewage treatment as well as insufficient system capacity to handle storm runoff.

Said Grant, "Americans take unlimited supplies of clean water and our water, sewer and drainage systems, for granted. Unfortunately, we have begun to learn the value of water the hard way." □



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