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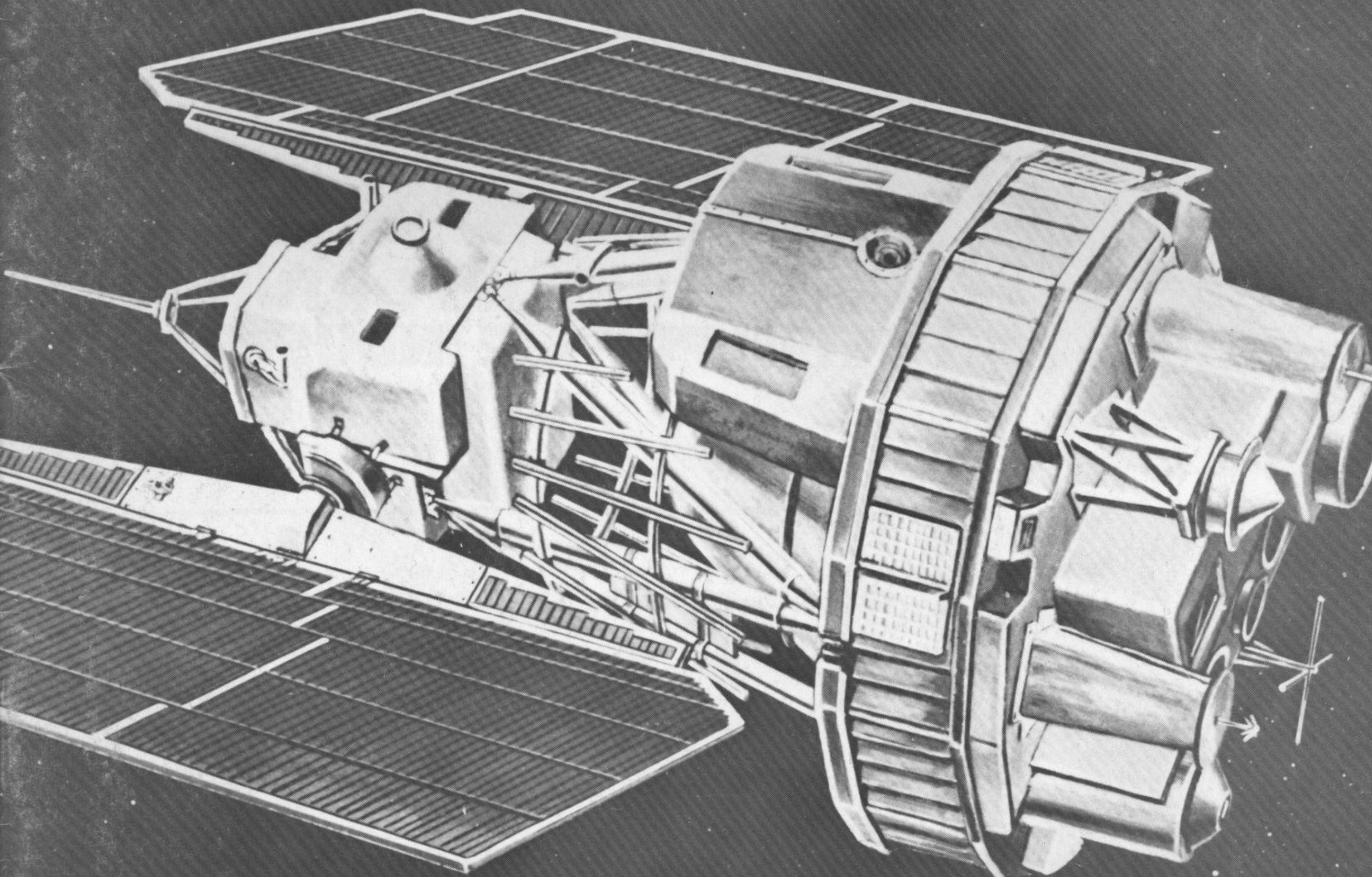
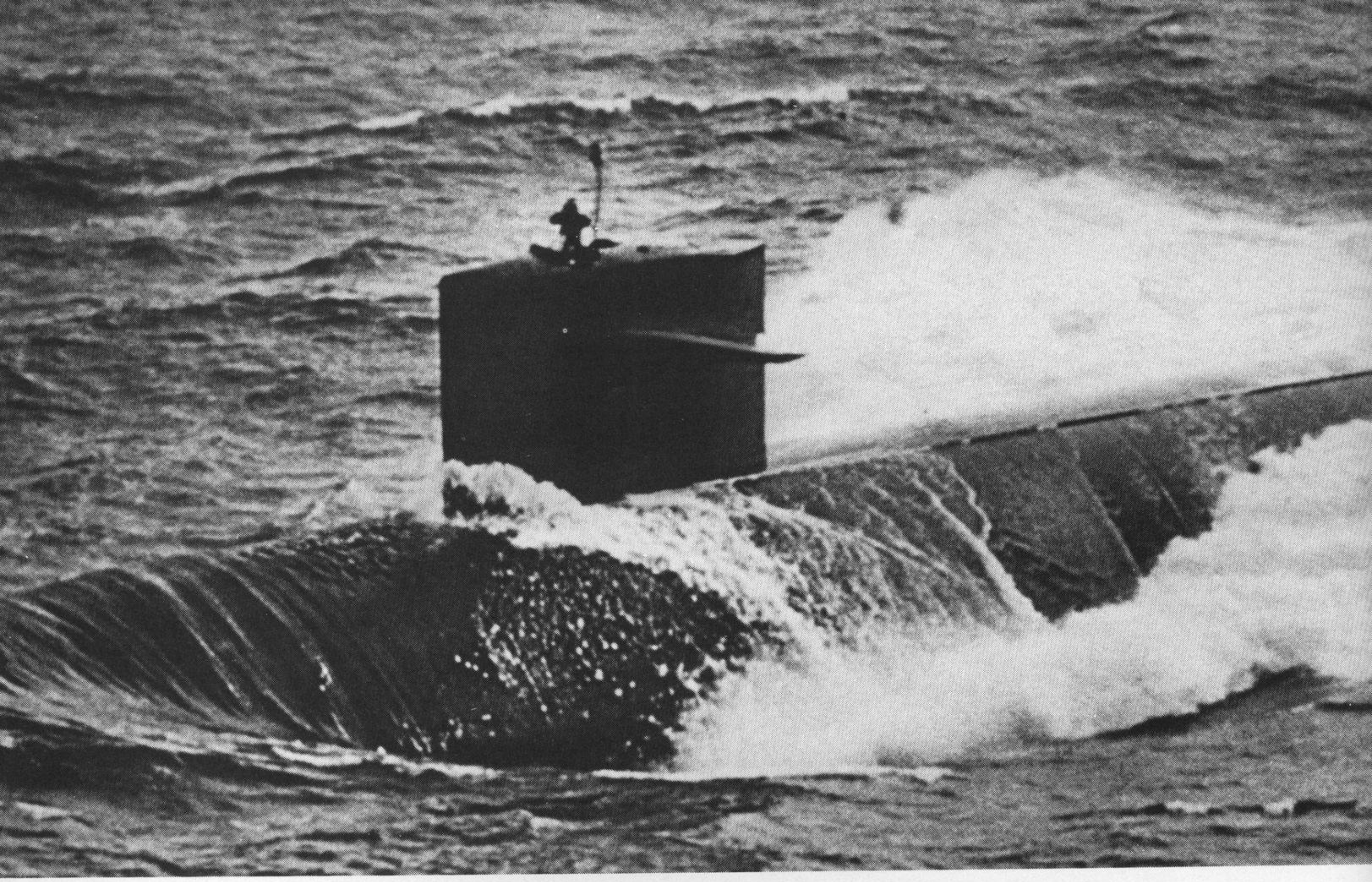
Volume 83, No. 3 February 1979

wisconsin engineer

EYES in the SKY



WHO SEES WHAT FROM SATELLITES —THE STORM OVER REMOTE SENSING CLASSIFICATION



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wisconsin engineer

PUBLISHED BY THE ENGINEERING STUDENTS OF THE UNIVERSITY OF WISCONSIN–MADISON, FEB. 1979

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Editors: *Bill Bridgers and Sue Tyunaitis.* **Business Manager:** *Sue Blockstein.* **Advertising Editor:** *Jeff Sokol.* **Photography Editor:** *John Wardale.* **Managing Editor:** *John Socha.* **Circulation Editors:** *Delores Malloy and Judith Dodd.* **Layout Editor:** *Betsy Mayer.* **Contributing Writers:** *Don Slavik, Joanne Haas, David Mathisen, Nikki Abramoff, Pat Gureski, Ken Kusel, Kathy Howard.* **Wordsearch:** *Dan Zietlow.* **Board of Directors:** *Prof. George R. Sell, Prof. Howard J. Schwebke, Prof. Wayne K. Neill, Prof. C. A. Ranous, Prof. Charles G. Salmon, Assoc. Prof. Richard Moll, Asst. Prof. Raymond B. Esser, Asst. Dean Richard Hosman, Ann Bitter.* **Faculty Advisors:** *Ann Bitter and Howard Schwebke.*

Cover: LANDSAT I *satellite, artist's rendition, courtesy NASA. See story page 14.*

editorial

by Bill Bridgers

This issue of the *Wisconsin Engineer* represents something of a break from the past. Ordinarily, the magazine runs a number of shorter articles on a wide range of topics. Due to financial limitations, it has been impossible to feature more lengthy or detailed stories. Unfortunately, some of the best reading doesn't fit into a page or two. We believe that the interview with Dean Marshall and the cover story on remote sensing by David Mathisen are important enough to make room for them in the magazine. We hope you will agree.

Dean Marshall's comments provide an excellent point of reference for what we hope will be a new direction for the *Wisconsin Engineer.* It has been a tough uphill battle trying to make this publication something that speaks for (and has something to say to) the engineering community of the University, its alumni, its friends and sponsors. There is a lot to be said for the work being done at this University and the people who are involved in it. This magazine provides a means for those in engineering and related fields to communicate with their colleagues in the community.

We're seeking to make this publication a more vital component in the lives of the engineers of Wisconsin, so the next few issues of the magazine will focus on subjects of crucial importance to the future of our profession. We are grateful to Dean Marshall for setting the stage. Our interview with him provides the comprehensive picture for the more detailed stories that will follow in upcoming issues. Anticipating this, we posed our questions to touch on specific points.

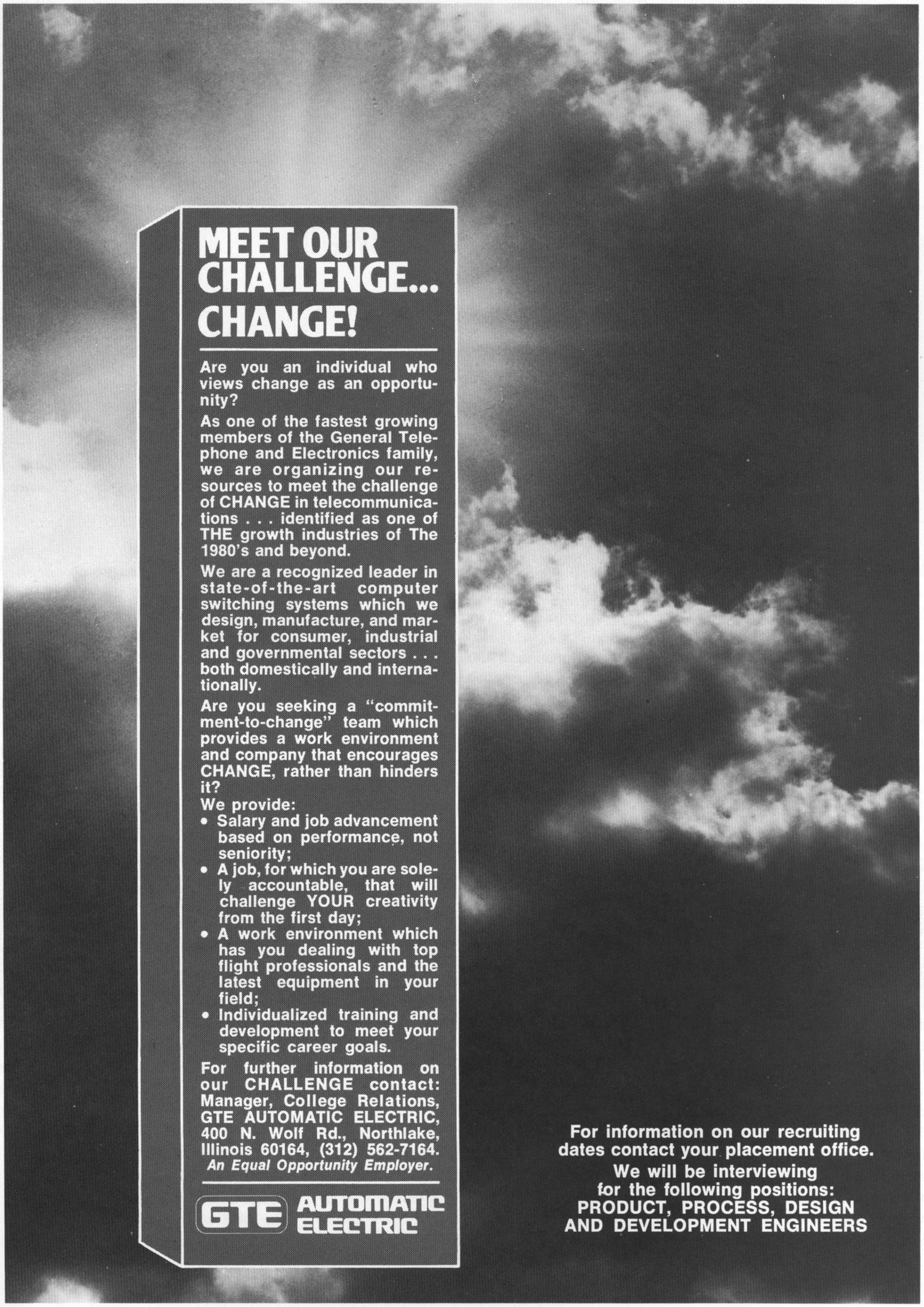
David Mathisen's article speaks for itself. We extend our thanks to him for allowing us to reprint his controversial story. We believe it provides a fine example of investigative journalism in a technical area.

Wisconsin Engineer welcomes your response to editorials and stories.

business cents

Sue Tyunaitis finishes her career as editor of the *Wisconsin Engineer* with this issue. During this past year Sue has greatly improved the magazine's quality. The *Wisconsin Engineer* now comes out regularly, five times a year, with greatly improved content and layout. As one who has been swept along by Sue's enthusiasm, I would like to devote my bit of editorial space to extending the staff's thanks to Sue.

Sue has almost single-handedly resurrected the magazine. She has been instrumental in encouraging people's involvement. I think the best way to thank Sue is to carry on her work. The editorial staff will make every effort to continue to upgrade the quality of the magazine and to give its readers an engineering publication worthy of their interest.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The big picture

–an interview with Dean Marshall

WE felt that an interview with the Dean of the College of Engineering was long overdue. We hope that you will find his comments as insightful and timely as we did.

W. Robert Marshall has been Dean of the College of Engineering at the University of Wisconsin–Madison since July, 1971. Prior to filling this position, Dean Marshall was a member of the faculty of the Chemical Engineering Department here. He joined the faculty in 1948 after several years with E. I. DuPont De Nemours and Company.

His research and academic interests have been in the fields of heat and mass transfer as related to drying operations. He is a graduate of the Illinois Institute of Technology and received his PhD in Chemical Engineering at the University of Wisconsin in 1941.

Bill Bridgers, the new editor of the Wisconsin Engineer, interviewed Dean Marshall shortly after his return from Indonesia last month.

Let's begin with a general question about engineering in the 80's. Can you give us an idea of what the engineering picture looks like for the next ten years? As a dean and a person who has been in the profession for quite some time perhaps you can see some different trends.

I think it's possible to divide engineering and its development into definable eras. The first one is the pre-World War II era. In this engineering was devoted to building roads, sanitary systems, etc. . . . old-fashioned engineering. Certain branches of engineering were somewhat more advanced and others were just beginning to come along. The field of electronics was virtually nonexistent. You could spot an engineer by the slide rule on his belt.

World War II caused a dramatic change and provided a much broader science base for engineering. During that period science and technology developed at a rate which doesn't occur during peacetime. Engineering education took a dramatic leap at that time. The engineer was not as much of an empiricist as he was before. In my own field of chemical engineering, new principles were developed to design very sophisticated chemical processes which led to the creation of all of our plastic industries and synthetic materials. At the same time, the computer came into being. This really was a revolution.

From about 1950 up through about 1970 we have the so-called second era which was characterized by very rapid developments of our understanding of nature and materials. Clearly, the development of nuclear energy from the war became a very major concern. Other breakthroughs came in biochemistry, pharmaceutical products, and electronics.

"Engineering clearly is going to be interacting and interfacing more with the social sciences."

Sometime around 1970 we moved into an era where the engineering profession had to take cognizance of the needs of society, the problems that society faced. The technologists and engineers are very often accused of having created many of the problems with which society now contends. Well, that you can debate for a long time. Whether or not we created it or whether the products of technology were not used in the best possible way is something which is not clear cut. I don't think, for example, that the impact of television on the behavior of society was foreseeable.

As we move into the next decade, engineering clearly is going to be interacting and interfacing more with the social sciences in a much stronger manner and in more novel ways. I believe that the engineer is going to take the lead in this. That is easily explained since the engineers understand technology and the social scientists don't.

What we have to do in engineering education is to try to develop opportunities and programs for students to learn more about fields like political science. I guess law may be about as important an area for the engineer to become more acquainted with than he has in the past. The practice of engineering in the future is going to be highly affected by the laws that are passed by legislatures and Congress. That is extremely self-evident today. We are right in the middle of the dilemmas that have been posed by Congress. In their haste to control technology, they have passed laws which are unenforceable in some respects. What I have maintained for a long time is that you can legislate man-made laws, but you can't legislate laws of nature. That brings to mind my favorite story about the legislature that wanted to round π off to 3.00!

You mentioned that in the 1980's you feel that engineering will be going in the direction of more interaction with the social sciences. The University of Wisconsin–Madison is a leader in the so-

Photo by John Socha

cial sciences. Would you say that that will give students here in engineering some sort of an edge over students in engineering schools elsewhere?

Very definitely. Yet, I think there is always a question of whether we will capitalize on that because it takes two to tango. You have to have the joining together of the different areas. This has happened in the past. One of our professors today is working with an anthropologist. Others are working with social scientists in trying to teach them systems concepts. This is very important. So, we probably have one of the best opportunities, the best universities in the country to carry this forward.

On the subject of engineering education, does it seem to you that the demands on the student are becoming almost excessive in terms of the amount that an engineer needs to know, not only in the rapidly advancing technical areas, but also the new social aspects? Can you give us some idea about what's going on in the minds of the administrators and educators in looking at these new developments?

It's accurate to say that there is an attempt to restructure things. It's not widespread in that every department is involved. We have a number of faculty from several departments that have been interested in doing something more positive along these lines. There is the Socio-Technical Design System Group which Professor Nadler chairs. They had a conference here in the early part of November directed toward engineering for non-engineers. There was quite a bit of interest expressed by deans from other colleges who attended the meeting. So, it may come to pass that in the 80's there will be a more structured effort to carry out these interactions with the social sciences. In a more informal way, we have faculty working with other faculty in areas that are relatively new to engineering, if you think of the years when I studied engineering. We have a lot of our faculty, for instance, working with the medical school. We have in General Engineering the potential for an interdisciplinary type of department where we bring together faculty of different backgrounds. We have developed about twenty-five courses which have been designed deliberatley for the non-engineering student. So far, we have not developed a core curriculum from which the student from L&S could build a degree. It could be done, but it's going to require the willingness of L&S to give necessary credit.

This is obviously going to entail cooperation between the university and the engineering campus. Historically, there has been a feeling on the part of some members of the university community that the engineers are not really part of the "academic" world. Is that changing?

Well, I like to think it's improving. Students are my best source of information on that subject because I don't know as well as they do how well they are accepted by their colleagues in other fields. I keep hearing some of the old cliches of years back. I don't think engineering students are missing out on all the good things. I don't believe that that is necessarily true any more.

Let me take as an example that in 1960 we established a program for engineering students to study abroad. [See story on page 26]. We were the first engineering college in the country even to consider providing an opportunity for a student in his junior year to study in another country, another culture. I think it has created an interest on the part of a certain number of engineering students in foreign studies and foreign language.

Many of our faculty have helped stimulate interest on the part of our students in some of the other colleges. I do believe that we don't yet have the recognition from colleagues on the hill that engineering may be ahead of a lot of the other colleges in this area. Foreign programs is an example. Incidentally, this could be one of our directions in the rest of this century: more involvement with more countries in developing programs.

One of the major obstacles that we have to overcome before any of this can become a reality is somehow dealing with a problem you mentioned earlier, which is the idea that engineers are responsible for the problems of the world in which we live. There seems to be a growing wariness of technology on the part of a large segment of the population. There is a feeling that technical developments are going ahead without the awareness or consent of the public. Do you see a confrontation coming or do you feel that there is going to be a meeting of the minds somewhere down the road?

We have had confrontations. We may continue to have them. I am somewhat optimistic about there being a better understanding about engineering and its goals. I see this right here in the university where more students are transferring into engineering from L&S than I have seen in decades. Why are they doing this? I believe one clear cut reason is that many students realize that they are going to live in a technologically-oriented world whether they like it or not. The better understanding they have of that, the better they are able to live and cope with it. We have had students who have actually completed degrees in Letters and Science, women in particular, and are now in engineering. They are going to have a very good education.

This brings up the phenomenon of the increased interest in engineering by women. Much of the public has no conception of how many women are coming into engineering. I don't know where that will end. Right now we are at 12%, which is a considerable number.

My answer to your question about whether or not we will continue to have confrontation is that I think we will solve that through education. It is my feeling that the colleges of engineering in the large universities are working very hard to expand the opportunity to study engineering for other students who want it.

We have certain areas in our college where the interest is very strong. One of these is materials science, where we have enrollments we almost can't handle. They range everywhere from Family Resources and Consumer Sciences majors to artists. Materials pervade our lives. Progress in science has always been dependent on progress in development of materials. It affects every discipline in one way or another. There are other areas that are popular to students—artists study welding, landscape architects study surveying, etc.

Let's talk about your job and what you feel you can do to bring about a greater public understanding of technology and to provide an overview, a worldview of the relationship between the university, industry, and society in general.

"My job here is a difficult one to describe... it generally is to make it possible for our faculty to do what they want to do and what they feel is important."

Mine is basically a job in communications. How can one effectively develop means to deal with different groups and get information to them. In one respect, we have had some very successful conferences with industrial executives in telling them about the College of Engineering. It is really surprising to me how little is known by our own state industry about the resources that exist here. You know, every time we have a meeting with industry, there are two or three companies that come back to us and say something like, "We didn't know you were in the field of microprocessors. We've been going to Stanford University and here it is right in Madison." Communications is a very, very important part of all this. I see my role as trying to improve this.

We have, of course, the Engineering Expo every two years. That isn't something I started, but something that I certainly support. [See feature on pg. 30].

We have done a great deal to try to work with high school teachers.

My job here is a difficult one to describe because it doesn't have a job description. The way I describe it generally is to make it possible for our faculty to do what they want to do and do what they feel is important. If I had a faculty member that didn't know what (s)he wanted to do, I would be deeply concerned. I don't think it's the job of a dean to tell the faculty what they should be teaching in their courses or in their research. That has to be tempered as far as generalizing goes because Wisconsin is a different kind of university. The faculty governs here. The faculty are hired on the basis of their potential ability to teach well, to do good research, to be able to transfer that research into the classroom, and to know what is the important field to work in. This contrasts with some other schools that are dominated by the administration and where the faculty is more or less told what to do. The only measure that I can see of having been successful at this job is seeing who has come into the faculty. Over the years the new faculty have proven to be very outstanding. They have done a great deal to place this college among the top ten schools of engineering.

Then, of course, the lifeblood of our whole operation here is the student. That is really one of the great pleasures and stimulations of all of us here to see the fine students that have come through and

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After all of these optimistic words, it's a shame to have to turn to a more somber subject, but maybe you can touch on this briefly. What is the effect of the economic belt-tightening on the College of Engineering and the University in general?

Yes, this is going to have significant impact. If you're talking about budget, faculty salaries, other restrictions, this is of great concern. I don't know quite frankly where we are going to go. I don't know what our new governor's views are on this. Our faculty in the College of Engineering is really behind other universities in the area salary-wise. We have restrictions on our ability to reward those faculty that in my opinion should be rewarded. There are limitations on the salary increases that can be given to the faculty as a whole. We have so many good faculty that you can't give them all an increase of 15% and maintain an overall increase of only 7%. That is one of the new problems of the last few years that is making the job of being a dean more difficult, and less satisfying. We have many good people here, many of whom could leave at substantially larger salaries. They haven't so far. Obviously, Wisconsin is a place people like to be, particularly Madison. Wisconsin has weathered some rather difficult periods in the past. I'm optimistic that we will come out all right, and I think part of the reason is that the administration has come out for the faculty. I think if we ever reach a point where we have professional managers running the school who do not understand the faculty then we're in trouble.

Is there anything that you can think to add to what we've said that would be directed specifically to the students?

Well, I would like to see the students of the College, as much as they can with their heavy loads, become more involved with the affairs of their college, one, and their unviersity, two. Engineering students are not what I would call politically-oriented. I would like to see more involvement in WSA and similar arenas. I know that engineering students are busy, that they are very practical with their time. I do think that they involve themselves in things more than some people give them credit for. I believe that it would be desirable that they become as conscious as possible about things such as legislative activities. You know we have an engineering graduate down in the legislative council, John Stolzenberg. That was a real breakthrough in convincing the head of the legislative council staff that they could benefit from a technically trained person as well as a lawyer. [See story on pg. 10].

I would like to see more students become interested in the *Wisconsin Engineer.* I really think that the student who develops an ability to write and communicate has a real advantage. I know that we talk about this a great deal. I can go back and get you papers that are sixty years old that talk about the need to teach the engineer how to write and communicate. I think today it's more critical than ever before. I hope they will stand in line to help you with your publication.

We could use some help. What better place to end it than on a plug for us. We want to thank you for your time and your thoughts.

word search

A	B	R	S	I	N	D	I	F	S	A	S	A	N	S	E	T
P	E	C	D	T	R	I	F	E	N	C	I	G	E	A	B	S
E	N	O	N	E	F	E	W	W	I	T	D	E	E	T	B	O
X	G	O	R	E	V	O	L	C	F	A	E	L	R	U	O	F
K	I	F	O	N	I	L	H	A	I	Z	S	O	G	D	R	T
A	N	L	B	I	E	L	C	I	N	A	O	B	C	R	A	Z
N	E	E	B	T	G	I	L	O	G	D	F	O	O	D	N	O
S	E	E	O	N	L	T	E	B	D	O	M	M	N	A	G	M
A	R	T	I	E	L	S	O	R	E	C	A	F	O	O	E	C
S	O	W	A	L	E	T	T	O	T	O	R	E	N	Q	M	C
A	A	G	N	A	S	L	E	P	R	E	C	H	A	U	N	O
N	O	O	C	V	N	T	R	I	A	D	H	A	O	E	I	Y
D	C	D	O	T	E	O	R	S	A	T	U	R	N	E	L	Y
S	L	M	W	S	E	R	I	D	H	U	R	B	E	N	B	C
F	A	A	A	R	S	T	E	L	M	O	N	I	E	D	U	O
U	N	C	S	H	A	M	R	O	C	K	O	T	C	A	D	Y
N	O	T	E	S	E	N	D	U	B	A	D	E	C	K	G	G

Hint: Number 1 is already solved!

Clues

1 Patron Saint of Ireland
2 Irish or Scottish Family
3 March 15
4 Three leaf clover
5 Irish Protestant's Color
6 Irish Fairy
7 O'Brien's Homeland
8 The Real — — — — — (Irish name)
9 Capital of Ireland
10 Good luck charm
11 Patron Saint of Sailors
12 Irish Language
13 Irish — — — — — — — (Dog)
14 St. Patrick won an — — — — — — — —
15 Irish Girl
16 Martyr of 3rd Century
17 Irish Catholic's Color

Answers on page 23.

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The laws of nature & the laws of man

the science staff of the wisconsin legislative council

by Donald H. Slavik

As we find our lives being affected more and more by technology, we can notice an increasing interest in using and regulating new technologies by the government. The Federal Government was probably the first to pass laws implementing and controlling the use of our engineering achievements in such areas as regulation of the railroads. Lately, state governments have taken a larger role in trying to use science to solve social problems and to control our new technologies.

To learn more about the integration of technical engineering knowledge with the law in Wisconsin, I went to see John Stolzenberg, Staff Scientist for the Wisconsin Legislative Council. This article is based upon our discussion.

In order to make the right decisions on the passage of bills, legislators must have an unbiased source of information on problems and solutions. Created by state statute, the Wisconsin Legislative Council is a politically independent information-gathering staff of professionals, charged with assisting major studies done by the State Legislature, issuing research documents, and preparing legislation related to such studies at the request of legislators.

To provide Wisconsin Legislators with an independent source of information and analysis on science-related topics, the Wisconsin Legislative Council hired a half-time graduate student as a "science analyst" in 1974. In 1975, the Wisconsin Legislature expanded this to a full time position. Presently, the Science Staff of the Council consists of four positions: Staff Scientist, John Stolzenberg; Science Analysts Julie Greenberg and Leslie Glustrom; and Science Research Assistant Kathy Lipp. These state employees have backgrounds in biochemistry, oceanography, energy, water resources management, chemical engineering, and environmental studies.

The Science Staff of the Council does not normally initiate research on its own, but rather acts in response to requests from legislators, committees, and occasionally the general public. The Staff members study the question or problem brought before them and then issue a report or memorandum. The Science Staff does not push for a particular resolution to a problem, but tries to present both sides in an unbiased way.

The reports issued vary considerably in both time taken to prepare and in printed length. They range from a short answer written in an afternoon to a lengthy document set for public distribution which may require months of preparation.

The Science Staff obtains technical information from a wide variety of sources. At the Capitol Building, the Staff maintains its own files and uses those of the Legislative Reference Bureau and the Legislative Fiscal Bureau. In Madison, the Staff makes extensive use of the UW-Madison staff and libraries, other state agencies, the Madison Public Library, and private industries. When necessary, the staff will call throughout the state or nation to get the information necessary to put together a report.

Presently, the Science Staff is working on many projects:

1) the certification of environmental labs, which may subsequently lead to a bill before the legislature;

2) odors from foundries leading to new regulations;

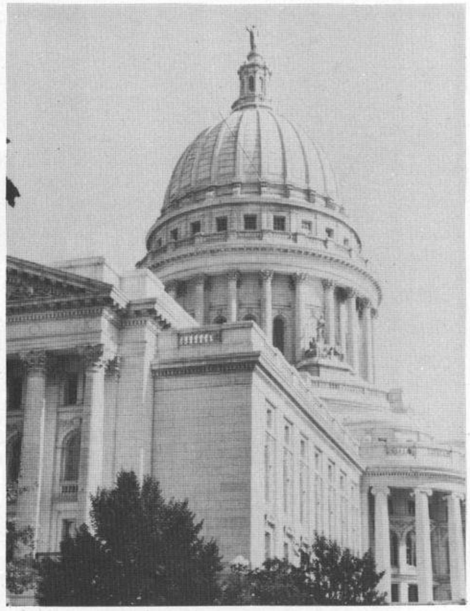
3) revision of the administrative rules implementing the solar tax credit law;

4) alternative rate structures for electric utilities;

5) radioactive waste management, leading to a bill before the state legislature;

6) implementation of the Clean Air Act;

7) reduction and recycling of solid wastes.



The Science Staff of the Wisconsin Legislative Council is the vehicle by which state legislators obtain the technical information necessary to determine the merits of a bill before them. Engineers and scientists working on the staff have important roles in providing information on state-government decisions concerning the public-at-large. This is a fine example of a way in which science and law come head-to-head in everyday life.

Don Slavik has a degree in Nuclear Engineering from UW–Madison and is currently a first year law student here. He is interested in the integration of the law and sciences.

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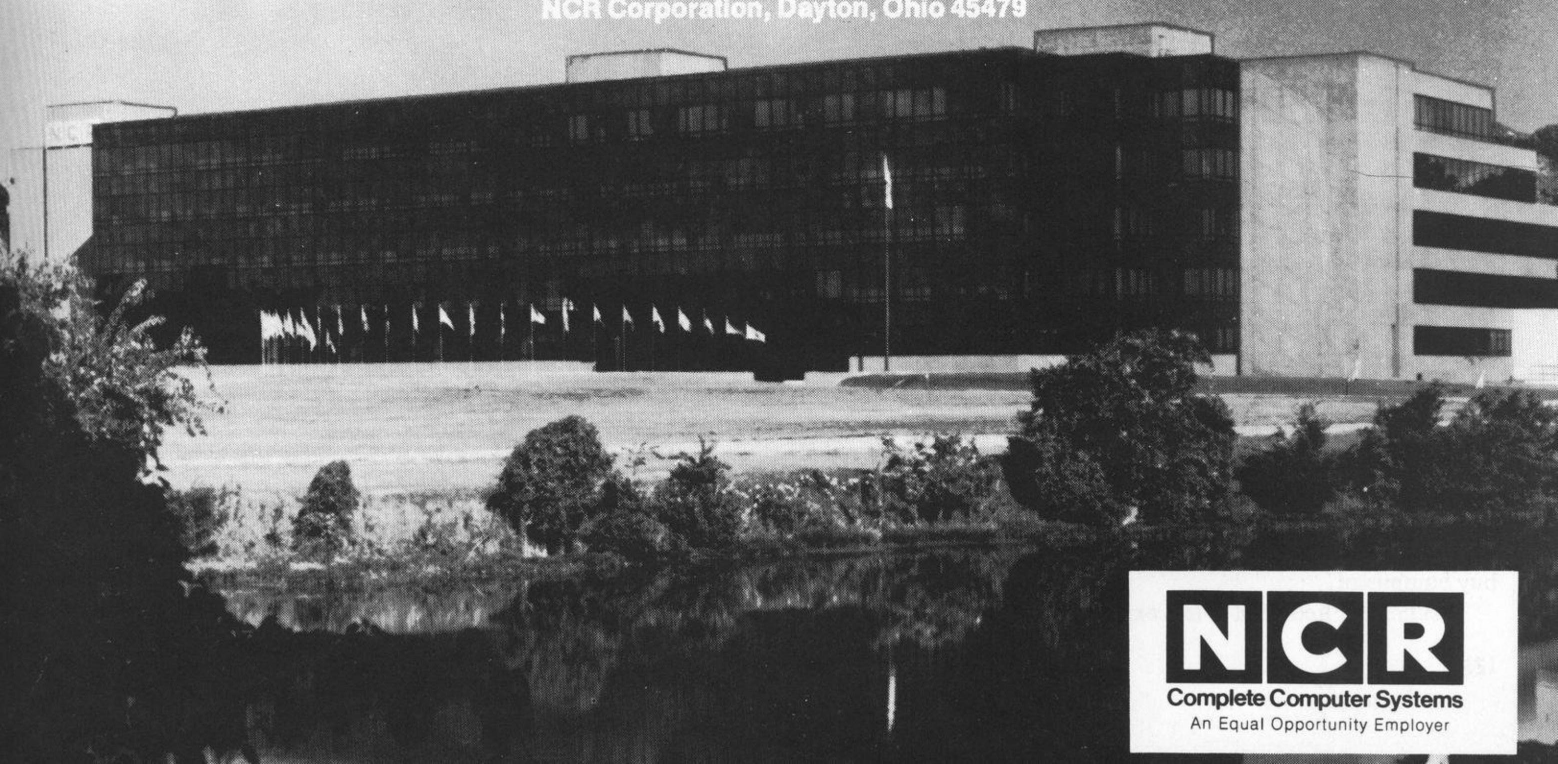

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Slip sliding away

cross country skiing

by Joanne M. Haas

Cross country skiing is one of the most popular winter sports among college students today. Many take to the outdoors once the snow begins to fly to relax, exercise, and enjoy themselves by cross country skiing.

Is it difficult?

No. If you can walk, you can cross country ski.

There are few sports that match the physical exertion it demands and the physical benefits it offers.

Cross country skiers burn from 800 to 2000 calories an hour. They also have some of the highest oxygen intake rates of all athletes. As far as cardiovascular improvement, cross country skiing ranks at the top of most activities.

Skiers find that their cross country sessions enhance practically every other sport. Runners are faster, tennis players are more fluid, and dancers are more precise. Even walking becomes more enjoyable.

Cross country skiing is one of the best overall conditioning sports you can do. The simultaneous arm and leg movements keep the heart and lungs pumping hard while toning your muscles and burning hundreds of calories.

Yet, the physical demands of the sport are not unreasonable. Some experts call the activity a "soft sport" because it stresses easy, smooth kicking and gliding over soft snow.

Those who suffer from pains in the knees, calves, and the Achilles tendon find that cross country skiing does not bother these conditions. Sometimes it even helps.

However, there are a few catches to enjoying this winter-fun. The main one is having enough money on hand to rent or buy equipment.

If skiing is a hobby, it is less expensive to buy your own equipment. But, if you just cross country once in a while, renting is the less expensive.

Once you become used to the cross country skiing technique, you may decide to purchase your own equipment.

Unlike downhill skiing, the cross country equipment is relatively cheap. For about $100, you can buy a fairly decent set of skis which will last many seasons.

When you go to buy, you will find three basic types of skis: touring skis, 50 to 60 millimeters (two and a fourth inches) wide under the foot; light touring skis, 52 to 56 millimeters (two inches); and racing skis, 48 to 59 millimeters (under two inches).

Touring skis weigh between five and six pounds, making them stiffer and less apt to break. This ski gives a more stable and controlled feeling. It is most popular in the western North American areas.

Light touring skis are recommended for the beginner and veteran skier. They are lighter, more flexible skis. Skiing on them is somewhat easier.

Racing skis weigh as little as three pounds. They are the most maneuverable and flexible. However, they are also more likely to break. Racing skis are only for racers. Never use them trail-breaking in the woods.

Ten years ago, the wood ski with the toe and heel cable was the only type available.

Today, you can still get the all-wood type of ski, but fiberglass/wood and all fiberglass skis are very popular. Many of these skis are laminated to make them stronger and reduce chances of warping.

Advancements in waxing have also occurred. The days of seven waxes and tedious toil are gone. The entire process is now conveniently reduced to two waxes, one for dry skis and one for wet skis.

Photo by John Wardale

Waxing is all-important for a good kick.

Yet, both waxless and waxable skis are available.

As you ski, one-third of your momentum comes from pole power. And there are four types of poles: metal, fiberglass, tonkin and bamboo. Bamboo poles are the most inexpensive, and they are used by the majority of skiers.

Cross country boots resemble running shoes and they weigh about the same. When you are trying them on, wear the amount of socks you will wear skiing. You want them to fit as snug as a running or walking shoe.

The next step is getting out there and trying it. Prepared trails are available in the area. Woods, parks and the arboretum also offer havens for the cross country skier.

It is fun to go out alone and experience the "determination of the lonely, Nordic skier". And going with a group offers its own challenges.

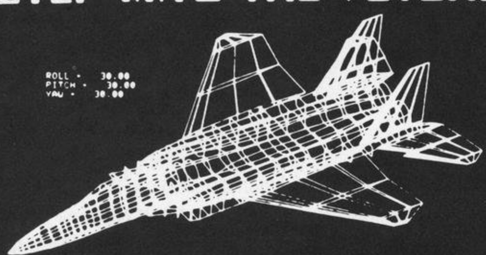
Any way you try this exhilarating sport, have fun.

Joanne M. Haas is a senior in journalism. She is the fine arts editor for the Badger Herald.

Photos by John Wardle

Joanne demonstrates some fine technique in the Arboretum.

STEP INTO THE FUTURE



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The unfulfilled promises of remote sensing

The *Wisconsin Engineer* is pleased to reproduce the following excerpted article on remote sensing by David Mathisen, a graduate student at UW-Madison specializing in remote sensing and environmental protection. The article originally appeared in the *New Engineer*, June/July 1978, unleashing a storm of controversy. The impact that this article had on government classification of remote sensing systems has been so significant, WE felt compelled to devote considerable space in this issue to reprinting the article and providing our readers with an update of the developments that have occurred since the article's appearance last summer.

Remote sensing technology is crucial to effecting environmental monitoring and thereby ameliorating the environmental crisis which may well render mankind extinct within the next century. However, military security has kept all but the crudest remote sensing systems classified–hence unavailable to civilians for environmental protection applications.

As the article describes, the outlook for remedying this very real barrier to effective environmental protection was very bleak indeed up until August, 1978. Prior to that, Congressional hearings and Administration officials' opinions clearly demonstrated a trend toward even stricter classification. In early 1978, President Carter commissioned a special Presidential Review Committee to look into the problem and come up with detailed recommendations regarding possible declassification. The committee members were not, in Mathisen's opinion, well-versed in either remote sensing technology or environmental monitoring techniques, and were very poorly qualified to evaluate the need for advanced remote sensing technology for environmental protection. The result was that their recommendations were biased toward the military. The committee strongly advised **more** restrictions on civilian use.

It would probably have been a decade before a serious reevaluation of the committee's recommendations could have been made had it not been for the article written by Mathisen and for the courage of several University of Wisconsin Civil Engineering professors, notably Drs. Frank Scarpace and James Scherz. It is always dangerous for anyone interested in receiving federal research grants to get involved in anything controversial. The question of remote sensing classification was quite volatile. It involved meeting the most powerful federal agency, the Department of Defense, head-on regarding its most sophisticated technology. In allowing their insights into the problem to be quoted in the article, Scarpace and Scherz jeopardized the funding of their research, the *raison d'être* of a university professor.

Mathisen notes that while he was researching the article, an expert on U.S. Space Policy who was to originally co-author the piece, was cautioned by government officials that it would "not be in his best interests" to do so. He then cancelled all participation in the article.

"Many people high in the remote sensing/ environmental protection hierarchy either would not discuss the question of military vs. civilian interests at all or insisted that their names not be mentioned," remarked Mathisen. "Of those who did allow me to quote them, Dr. Scarpace was the most helpful and courageous. He knew that researchers could lose federal grants for taking such a controversial stand. Yet, he was more interested in seeing that the truth was told. Dr. Scherz and Dr. Ralph Kiefer of University of Wisconsin-Madison were also very helpful and showed no misgivings about being compromised by my piece of investigative journalism."

The dedication of Mathisen and his sources to environmental protection paid off. Soon after the article appeared in *New Engineer* (which also deserves a lot of credit for having the courage to publish such a politically explosive piece) NASA ordered several thousand reprints of the article to be distributed among its employees. The U.S. Government Service ordered several thousand, as did the Department of the Interior and the Environmental Protection Agency. President Carter's science advisor and his space policy advisors also obtained copies and used them to bring pressure on President Carter to reconsider the recommendations of his review committee. Senator Proxmire wrote Mathisen, praising him for finally putting military vs. civilian remote sensing interests into proper perspective. Most importantly, Representative George E. Brown (D-Calif.), chairman of the Atmospheric and Environment Subcommittee of the House Science and Technology Committee, ordered the entire article read into *The Congressional Record* and used it as a basis to renew his efforts to break the military stranglehold on civilian remote sensing.

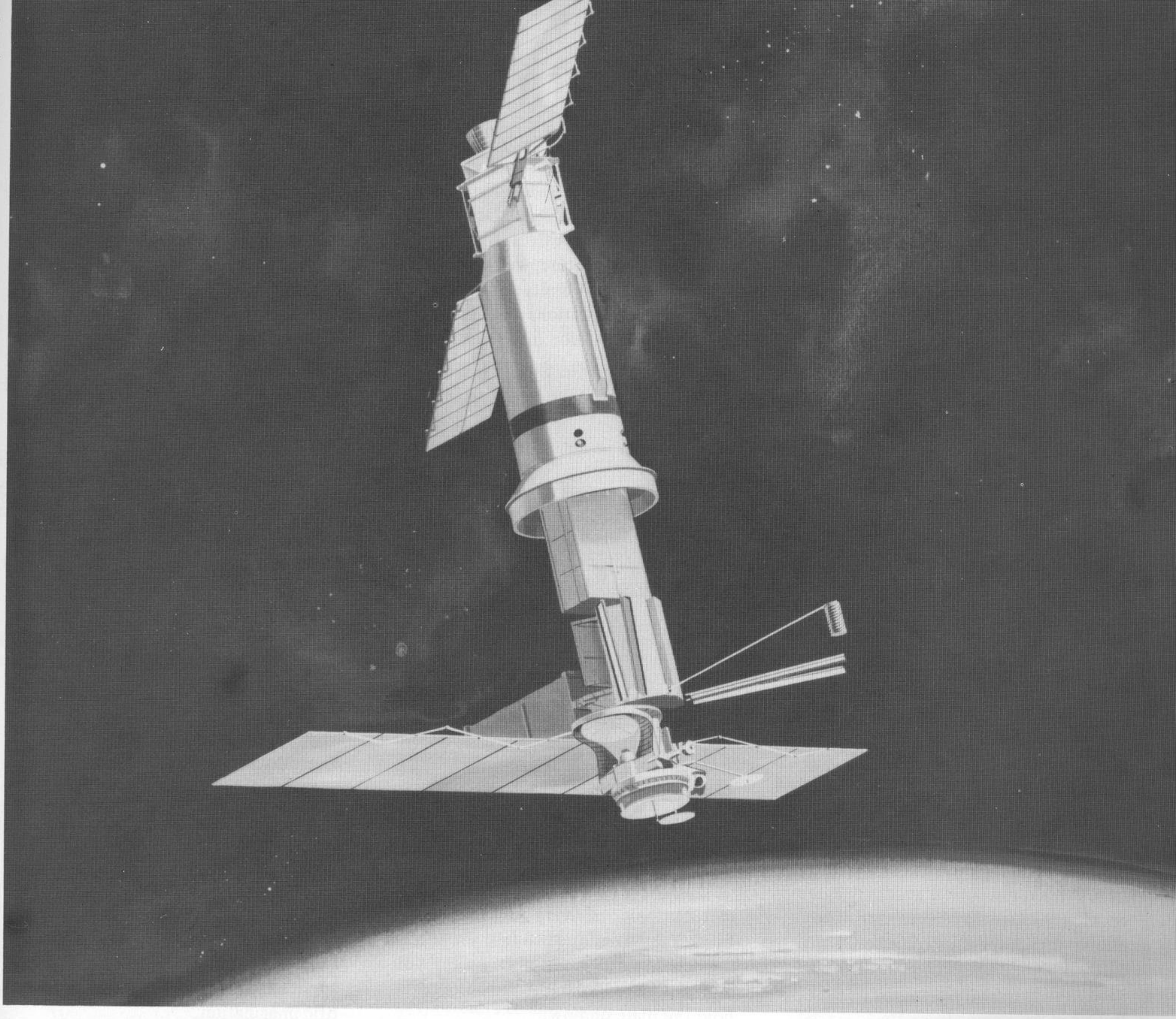
The United Nations has expressed interest. Mathisen received a request from them to do an in-depth report on global remote sensing for UNESCO's science journal.

Strangely enough, even the Army was happy that the truth had finally been brought to light. Mr. Mathisen received a call from the editor of the *Journal of the American Society of Military Engineers,* who requested that he write a similar piece for the Army journal. The journal editor noted that "the military was pleased to see this finally brought out into the open in your article. Many young military officials have long been concerned about this problem of over-classification and the serious harm it is doing to environmental protection efforts, but they could not speak out because their superiors–many of them old, ultra-conservative products of World War II–wouldn't stand for it. Now that *someone else* has brought it out, it's all right for *everyone* to talk about it and *do* something about it."

Indeed, something *is* being done. Just one month after Mathisen's article was published, President Carter, at the urging of his science advisor, Frank Press, created a new committee to review the findings of the previous one that recommended stricter classification. The new committee, which is expected to finish its final report sometime in February, stated that their recommendation will be for vastly increased declassification, down to the level of sophistication that civilian planners reported they needed when speaking with Mathisen.

On Sunday, November 19, 1978, the *Los Angeles Times* quoted a high Department of Interior official as saying: "That would advance our environmental protection work light years."

Mathisen left us with this final thought: "This should serve as a lesson to all professionals and students concerned with making technology socially relevant and optimally beneficial. You *can* do a lot more than just write your congressman. As an expert in your field of technology, you can research and write a documented, investigative article showing the truth to politicians either too busy or lacking in the necessary technical training to learn that truth for themselves. There will always be magazines like *New Engineer* who will publish well-researched, well-documented, and socially beneficial investigations into technology. Writers are a dime a dozen, but technical experts willing to communicate their insights to the public and to politicians are sorely needed–and in great demand by editors."


NASA photo

SEASAT-A, an oceanographic satellite, has run into national security problems effecting its usefulness in global monitoring of the oceans. Will future civilian systems continue to run head-on into DOD restrictions?

by David Mathisen

(Excerpted from the *New Engineer,* June/July 1978)

Those high-gloss, brightly colored pictures from the LANDSAT satellites have dazzled the public and brought good publicity (and funding) to the National Aeronautics and Space Administration (NASA). After all, the very idea of detecting—from the remoteness of space—conditions on and under the earth is the stuff of science fiction. More soberly, remote sensing technology promises to make possible a shift in environmental policy from "firefighting" to preventive action. Potential uses catalogued by researchers as long ago as 1962 included "protection and conservation of forested areas, investigations of water pollution, volcanology, thermal prospecting for mineral resources, detection of underground fires, detection of snow-field crevasses and reconnaissance of sea ice, and studies in many other areas of geology, agronomy, botany, oceanography, meteorology, and the like."

After 16 years, the promise is only partly fulfilled. The hoopla LANDSAT inspires has masked its poor reception among many civilians who might have use for it. The 60-meter resolution of the current satellite in the series, LANDSAT-3, is too crude for most purposes.

The satellite also carries a Return Beam Videcon (RBV) with a spatial resolution of about 30 meters, but radiometric resolution is poor and applications of the RBV have yet to be developed. Not that the satellite couldn't provide resolutions users say they need. The technology exists. It's just that the government is not about to come forward voluntarily with the next phase of technology transfer from the military into the civilian sector. The official reason is budgetary—the expense is too high. But logic and past experience suggest that the military's inertia is at fault.

Senator William Proxmire, despite his reputation as a penny-pincher, admits "There is no doubt that NASA's land satellite project could be a most helpful adjunct to current environmental monitoring efforts." He also noted Environmental Protection Agency officials say "that significant improvements must be made in LANDSAT's resolution, frequency of coverage, and speed of delivery of data products before it will be adequate for operational purposes," but that "international concerns as well as domestic military restrictions on spatial resolution limit the current usefulness of the LANDSAT project for environmental monitoring."

In the early sixties steady pressure from researchers and planners for release of some military sensing technology eventually produced partial declassification. With the impasse that has followed the unpublicized but real failures of LANDSAT, remote sensing technology should have seen another period of declassification. Civilian researchers generally agree on what they would like released. They also agree that the issue of national security is plainly irrelevant, for they don't need anywhere near the military's best. But since the clamor for more advanced technology comes at a time when our intelligence community seems dependent more than ever on sensor technology for spying, it is by no means certain that history will repeat itself.

The problem of increased civilian sensing needs surfaced during a NASA authorization hearing. Senator Frank Moss, Chairman of the Committee on Aeronautical and Space Sciences and Dr. Malcolm Currie, former director of Defense Research and Engineering for the Pentagon, could not meet eye to eye.

Moss pointed out the increased resolution that will be achieved by new generations of remote sensing spacecraft, and questioned if such high resolution would provide information important to national security. Currie retorted by saying, "we have discussed this intensively with NASA. Our conclusion is that while there may be some information there, the Department of Defense feels that this is all right. Now, as we go into the future, we may have to establish resolution limits on various kinds." These limitations would go beyond sensor resolution into sensor operating time, swath width, number of collectors, type of coverage, timeliness of data availability, quality of data processing, and even extent of dissemination of the data. In short, the military is seeking more secrecy rather than less, to keep a lid on sensor technology. Indeed, little, if any, of the military state of the art can be known by anyone without a top secret security clearance and a clearly established "need to know."

In December 1961, the lid was clamped on all information relating to remote sensing from military satellites. Continuing advances in electronics, and development of larger boosters, permitted significant upgrading of spy satellite capabilities in the sixties. Reconnaissance spacecraft now offer a wide range of sensing information, from various altitudes up to synchronous orbit and beyond.

Quality of the returned images is secret, but obviously very good. As one official said, "They used to talk about reading license plates from orbit. I think you may say we're looking at the bolts that hold the plate on now."

The late-sixties declassification—basically of thermal scanners with a spatial resolution of one milliradian, some advanced radar technology, and multi-spectral scanners for airplane (not satellite) use—nevertheless unleashed a "gold rush" by universities, civilian federal agencies, and private corporations to develop civilian applications. The major participants were the Institute of Science and Technology at the University of Michigan—now the Environmental Research Institute of Michigan (ERIM)—the Interior Department, the Department of Agriculture, the National Science Foundation, the Environmental Protection Agency, Bendix, HRB Singer, Daedalus Inc., and Purdue University's LARS (Laboratory for Applications of Remote Sensing). NASA, however, remains the major agency capable of performing advanced sensor research for civilians.

NASA does recognize the importance of getting advanced sensing technology into the hands of local civilian agencies. Recently NASA split the nation into three regions, each with its own Regional Applications Center "specifically charged with bringing the technology to state and local levels of government," according to a regional center official.

But all the organization-building in the world can't make up for the fact that very often the environmental features that concern planners—narrow streams and gullies, buildings, roads—are far smaller than LANDSAT can see. The planners say the federal government is more concerned with forcing their problems to fit existing NASA programs than with modifying the programs to suit local needs.

Most experts agree there is no reason why existing, but still classified, multispectral scanners with a resolution of 2 meters couldn't be used from satellite altitudes to monitor practically any environmental parameter of significance—from water and air pollution to urban housing density, to traffic flow on an interstate highway, to advance warning of developing crop diseases. Indeed, the range of Multi-spectral scanner (MSS) applications is limited only by the scientific imagination.

The research needs of Dr. Frank Scarpace at the University of Wisconsin are a case in point. Dr. Scarpace specializes in modeling power plant thermal plumes. "Of course we'd like to have the best resolution we can get," he says, "so we can look at small temperature variations for more accurate plume modeling. But right now the military effectively limits how accurately we can model thermal plumes by telling us the maximum temperature and spatial resolution we can use."

The only researchers with access to state-of-the-art knowledge are those under military contract. Their results are classified and they are forbidden to talk to their colleagues about them.

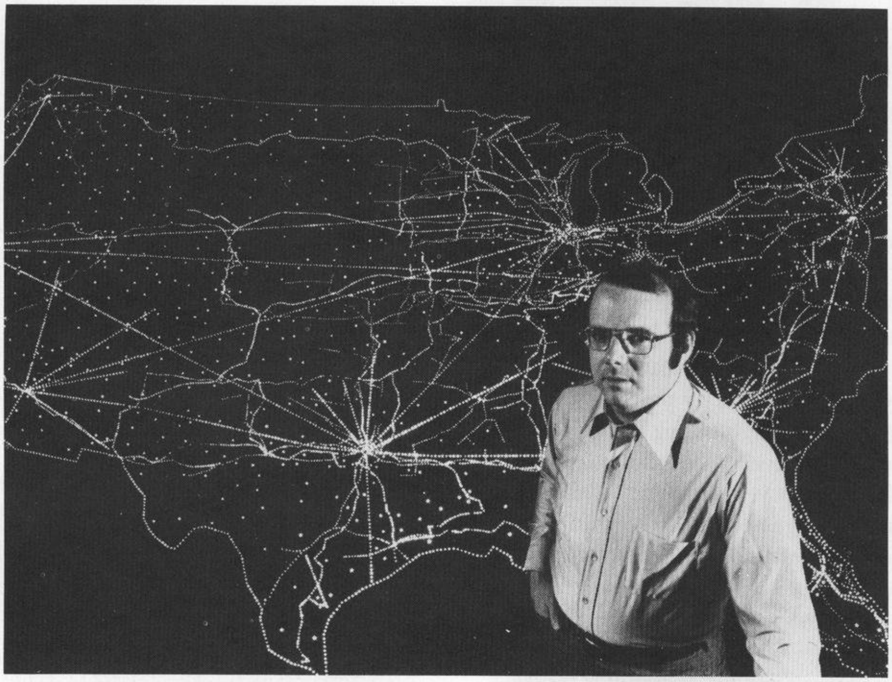
Don Hartman found a "model" way to troubleshoot the network.

The nationwide telecommunications network carries over 515 million phone calls on an average business day. Only a small number of them run into trouble, such as failing to go through the network, getting noise on the line, or being disconnected prematurely. Craftspeople in Bell telephone companies fix most of these problems quickly. But the causes of some can be difficult to find among one-billion-plus miles of circuits and thousands of switching offices.

For several years the Bell System used its computerized Network Operations Trouble Information System (NOTIS) to try to pinpoint those causes by analyzing trouble reports from all over the country. NOTIS was good. But Bell System managers wanted it to be better, more precise in identifying possible trouble spots. And they wanted the data in compact, easy-to-use form.

We assigned a new employee, Don Hartman, to improve NOTIS. Don came to us with a B.S. from the University of Texas and an M.S. and Ph.D. from Massachusetts Institute of Technology. He and his associates developed a second-generation system (NOTIS II) that does the job superbly.

For the new system, Don developed a mathematical model of the telecommunications network, including 28,000 local and



long-distance switching offices and nearly a half-million circuit groups. Don also designed the system software and served as a consultant to the team of Bell System programmers assigned to the project.

Each day trouble reports from the entire country are sent to the NOTIS II center in Atlanta. Overnight, the system analyzes the reports, processes them through the network model, and discerns trouble "patterns" which help identify potentially faulty equipment. By 8 a.m. the next day, via data links, analysts at phone company service centers receive information on troubles traceable to circuits or switching equipment in their territories. Result: Better equipment maintenance. And better service.

With NOTIS II up and running, Don has moved on to other projects. Today he's a supervisor with broad responsibilities for planning the telecommunications network of the future.

If you are interested in exploring equally challenging employment opportunities at Bell Labs, write to:

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From Science: Service

Baraboo Quadrangle, Wisconsin taken by LANDSAT, August 1974.

"I see the military as a black box," says Scarpace. "I'd really like to know what their state of the art is—that knowledge would help a lot with my research. As it is, we're working in the dark."

What the DOD is really interested in "hiding" is how far we have gone. If we have gone further than the Soviets and if the Soviets knew in what specific areas and by how much, they would immediately reorient their priorities to "catch up."

The whole key to this game of bluff is never to let "the other side" know exactly how good you are in any specific area, because if it finds out you're better, it will shift resource allocations to improve instrumentation and camouflage activities.

In view of the crucial importance of remote sensing to national security, the military enforces classification in two basic ways. The first is by preventing civilian agencies from building and using remote sensing instruments better than a certain accuracy—Scarpace's problem. This is fairly straightforward. The DOD publishes and distributes performance criteria called "Orders of Merit," beyond which it is simply illegal to build, market, or use a system.

Scarpace's *modus operandi* is typical. "My research effort is to take things that people have now—that are declassified and widely available—and make them as effective for valuable civilian applications as possible. So primarily I work with photographic techniques and digitized interpretation." But Scarpace is still liable to run afoul of the "black box," since he can never be sure of its boundaries.

Many researchers—like Professor James Scherz of the University of Wisconsin—just don't get involved in any area where resolution might be a problem. "My major research effort is in water quality analysis from satellite multi-spectral scans," says Scherz. "And LANDSAT-2 (one acre) resolution is perfect for that. A higher resolution would actually be worse."

The military enforces classification of advanced remote sensing technology such as MSS and radar quite differently when the proposed use is satellite scanning. There are no set rules. The military considers each as an individual case, and then monitors construction and launching of each satellite to make sure the established bounds for that particular satellite are met.

The LANDSAT's are an extra-special case. For them, the Office of Management and Budget (OMB) specifies the resolution to NASA. The military might have allowed a higher resolution than, say, the 60 meters being obtained with LANDSAT-3's MSS, but OMB enforced the lower resolution allegedly to keep NASA from spending too much money on the program.

We use the term allegedly because the question of whose interests really determine LANDSAT resolution is controversial. NASA usually wants the best it can get. The OMB appears to have the final say. Thomas O. Haig, executive director of the Space Science and Engineering Center at the University of Wisconsin, says that cost, not secrecy, is still the big problem. "The military has nothing to do with [LANDSAT resolutions]. The OMB sets those resolution limits so that NASA doesn't go on forever and ever spending more and more money building higher and

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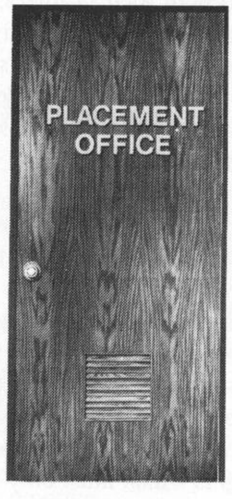

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higher resolution systems with data streams that no one could afford to store, let alone process."

However, it is possible that OMB is acting on behalf of the military in this regard. OMB normally checks to see if proposed research projects could duplicate technology already classified. If so, the budget office calls it "duplication of services" and throws it to the Defense Department.

Is NASA dominated by the military? "It's a myth," states Stanley Sadin of the NASA Office of Aeronautics and Space Technology (OAST). But with several key administrative positions held by former military officers, there are those not so convinced. "Even people inside NASA believe the myth," Sadin admits.

Indeed, mechanisms for this interaction are contained in the original 1958 NASA Space Charter which provides "the making available to agencies directly concerned with national defense of discoveries that have military value or significance, and the furnishings by such agencies, to the civilian agency established to control and direct nonmilitary aeronautical and space activities, of information as to discoveries which have value or significance to that agency." The charter also calls for ". . . the most effective utilization of the scientific and engineering resources of the U.S., with close cooperation among all interested agencies of the U.S. in order to avoid unnecessary duplication of effort, facilities, and equipment.

Thus it is probably safe to say that the 60-meter resolution being acquired by LANDSAT-3 is about as far as the military, acting through OMB, will go at this time for satellite MSS's.

OMB's decision aside, can the veil of secrecy be lifted to any degree without jeopardizing national security? The great irony of military classification seems to moot the question. It is that any civilian can legally achieve the same imaging that high-resolution military satellites can, simply by using airborne photographic methods. Ground resolutions of a fraction of a foot aren't difficult to achieve from a plane 20,000 feet up. It's as if the military is telling civilians, "You can image anything you want with photographic systems from airplanes, but not from satellites."

Even during the manned Apollo program, camera systems were carried with far better resolution capabilities than now orbit the earth in civilian satellites. Apollo lunar missions 15, 16, and 17 carried two camera systems used to photograph the lunar surface from 100 kilometers up. According to Farouk El-Baz, Research Director of the Center for Earth and Planetary Studies for the Air and Space Museum in Washington, D.C., "the accuracy of these maps of the moon is better than that of most maps of the United States, not to mention the rest of the world."

To date, NASA has not flown a camera in Earth orbit that is designed to produce steroscopic coverage adequate for topographic compilation. The use of such a camera was recommended by the National Academy of Sciences as early as 1967. After a number of efforts, primarily by Frederick Doyle, a research cartographer for the U.S. Geological Survey, NASA has finally agreed to fly a Large Format Camera system on several Space Shuttle flights. The reason for the long delay? According to Doyle, international sensitivities coupled with national security proved to be impossible hurdles.

Resolution of such a camera, depending on film type and orbital altitude of the Shuttle, could be as good as 10 meters. It is expected to produce geometric topographic maps from its orbital photographs at scales of 1:100,000 down to 1:25,000, according to Farouk El-Baz.

The rub for civilians, of course, is that high resolutions from photographic methods are very expensive if you want to use your data in digital form and are interested in covering large areas. Digitizing the resultant miles and miles of film would also be a formidable task. But the output of a scanner is already an analog electric signal which must only be run through an analog-to-digital converter to be rendered computer-compatible.

A second consideration in resolving the secrecy issue is the difference between military needs and civilian needs. "Comparing civilian remote sensing to military is like comparing apples and oranges," Tom Ory of Daedalus states flatly. "If you're building a military thermal scanner to find a guerrilla hidden away in the jungle in the middle of the night from 20,000 feet up, you'd have a totally different system than a civilian scanner for monitoring thermal plumes. The military is generally concerned with detecting point targets—with finding anomalies in the scanning field like missiles, battleships, or trucks. That's a completely different technology than, say, using a multi-spectral scanner to map land cover or population density.

"Civilians are interested in thermal scanners as primarily a temperature measuring tool. What use would they have for a high spatial resolution night reconnaissance instrument? So they spend lots of money on temperature calibration. The military couldn't care less about the exact temperature of something—they're concerned with relative temperatures—finding a specific object that is at a significantly different temperature than the surrounding area."

Wisconsin's Scarpace, an expert on thermal scanners, adds, "The military designs a thermal scanner so the voltage constantly changes with the average temperature. They want to always maximize temperature discrimination to find the anomalies—by maximizing the difference between the temperature of things in the current resolution cell. So if they hit something even slightly warmer than the background, the screen goes white. But that kind of a scanner would be horrible for thermal plume modeling—you'd lose all your information."

Researchers see a similar distinction between civilian satellite-borne multispectral scanners and their military counterpart. City planners, for instance, are not looking for anomalies—they're doing averaging. If they miss an occasional house or car they don't care. If the military misses a single tank, it could be fatal.

The same reasoning can be applied to radar applications. Civilians want to be able to exploit the unique ability of radar's long wave lengths to do environmental monitoring through heavy cloud covers, to monitor subsurface phenomena such as mineral deposits, or to monitor characteristics of large bodies of water.

The point is that civilians would have no reason to continually demand the best the military had—or even to use it if it were offered. Scarpace rests his case thusly: "The military tends to be interested in finding needles in haystacks. So they need better and better resolutions to get better at finding those needles. I can't imagine a civilian application oriented in any way like that."

Researchers in remote sensing who don't do classified work estimate military resolutions are between 20 and 100 times those currently available to civilians, depending on the type of sensor. The major exception to this is multi-spectral scanning from civilian satellites, where allowed resolutions are worse by one or two orders of magnitude than the resolutions civilians are allowed to get from planes with multi-spectral scanners; worse by three or four orders of magnitude than civilians can get with high-altitude aerial photography. LANDSAT-3's 60-meter MSS resolution may be worse by a factor of 400 than what the military is getting from its MSS satellites. The conclusion researchers draw from their estimates is that the military could declassify satellite MSS resolution far enough to give the civilian sector everything it could possibly use (about two meters) and still not get closer than a factor of between four and eight of its best.

Those few agencies which know enough to use existing LANDSAT imagery have also asked for higher resolutions. But on Capitol Hill there is frequent talk of "making LANDSAT pay for itself"—an idea that makes earth resource managers and environmentalists cringe. Most experts in the community of potential users agree that LANDSAT can't pay for itself—at least not now. Pricing the imagery high enough to do that would simply price most users right out of the market.

And even with minimal charges, technology transfer takes time. The more sophisticated the technology, the more time it takes to trickle down to the grass roots. Ninety-nine percent of the potential users of a high-resolution LANDSAT don't even know what the phrase "remote sensing" means, much less what a multi-spectral scanner (MSS) can do.

Yet OMB and its congressional allies don't buy the suggestion that demand for high-resolution imagery is temporarily and artificially low. The data point density required for high resolutions will incur dramatic increases in data processing costs, they maintain, effectively putting remote sensing beyond most users' means.

While the debate over demand continues, OMB refuses to give any federal agencies the go-ahead to start continuous operational programs based on LANDSAT. The result has been further "artificial" depression of demand for LANDSAT's wares, because at least a dozen state and regional agencies that, despite the obstacles, have found valuable applications for existing resolutions are fearful of committing themselves to a here-today-gone-tomorrow program.

Thomas Haig of the University of Wisconsin has one suggestion to break the impasse: "Instead of just complaining to NASA that their resolution isn't good enough, planners should be communicating directly with the federal agencies which control the purse strings to make their demand for cheap high resolution known."

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The consensus among researchers is that if the OMB and Congress could see sufficient civilian demand, they would pass along the necessary money and mandates to NASA—or to some other agency charged with administering an operational program, such as the Interior Department or the Environmental Protection Agency. Whether or not the military would put it's foot down if such a chain reaction occurred is not clear. But Haig, who works closely with the air force in meteorological satellite imagery distribution to civilians, points out: "Every time a legitimate civilian requirement has been established for any kind of sensor or information developed as a byproduct of military research, it has always been declassified and made available."

Will this continue to be the case? Until last summer, studies by the Administration, congressional testimony, and NASA's continuing dialog with the military suggested that civilians could expect less, rather than more.

In hearings held on the Earth Resources and Environmental Information System Act of 1977 by the Subcommittee on Science, Technology, and Space of the Senate's Committee on Commerce, Science, and Transportation last year, presidential science advisor Frank Press questioned civilian commitments. "There is a need for continued federal government support of research and development pertaining to remote sensing technology," he said. "We believe that LANDSAT-D (the next satellite in the series) represents this important commitment. The total NASA cost over the next six years is estimated to be $250 million.

"The administration concludes, however, that it is premature to commit the federal government to supporting an operational LANDSAT system because major uncertainties still exist as to the value and nature of future LANDSAT applications in public and private areas; evolution of remote-sensing technology, in general; and the general economic rationale for an operational system including the willingness of prospective government and private sector users to commit substantial budget resources necessary to utilize the data."

NASA and DOD do meet on a regular basis to sift through sensor technologies. "But it's clear we're headed for bigger and bigger problems. We're going to be in trouble with a capital T," emphasizes Sadin. Obviously NASA can't jeopardize national security, but Sadin qualifies his concern, saying that even with all the upcoming problems, "more and more opportunities for solutions arise."

Two recent incidents underscore what some fear to be the trend of the future. Both the Geos-3 and SEASAT A projects have fallen under military scrutiny. Both use radar to measure ocean topography, leading to a better understanding of ocean currents and tides, and a more precise description of the earth's gravity field and geometry. SEASAT is hailed by NASA as the first major step in demonstrating a global dynamics monitoring system.

However, both spacecraft can provide measurements which can be used to upgrade targeting of ballistic missiles. Variations in the pull of gravity, ever so slight at launch time, have a large effect on the eventual targeting error of warheads. Restrictions on access to SEASAT data have been set by the military. As a result of this and technical limitations, it is felt by some oceanographers that SEASAT is almost worthless scientifically.

Thus, on the surface at least, there is a question of whether resolution ought to be improved first, or whether the federal government is justified in waiting for "the user community" to step forward and demand it first. Isn't it really all of us who might benefit from better community planning and better defenses against environmental degradation? Why should the federal government treat local and regional planning departments as somehow divorced from the rest of the country?

President Carter is probably the best-equipped president since Thomas Jefferson to deal with environmental protection technology because, like Jefferson, he has an extensive background as both a farmer and an engineer. He is keenly aware of the problems civilians are facing with remote sensing technology and military classification. Early in 1978 he commissioned a special Presidential Review Committee to undertake a detailed study of the situation and come up with recommendations for possible reform.

These officials attempted to document all matters related to space which impacted national security, ostensibly to develop a unified policy for all government and civilian space activities, under Presidential Review Memorandom (PRM 23). The document was to evaluate the needs of intelligence community and defense department space programs, NASA activities, and commercial space systems. Central to the study was the possibility of relaxing restrictions on available satellite imagery and other data, and sharing such information with other federal agencies as well as other nations, including the Soviet Union. During periods of international conflict, the flow of such information could be cut off or screened, the draft report suggested. The policy document also considered regulation of private and government remote sensing, with programs that dip close to the 10-meter resolution limit to be reviewed on a case-by-case basis.

The study was carried out through the National Security Council's committee structure, with a rating of "Top Secret" which many feel was unnecessary. Although the policy paper was developed with opinions from a wide cross section of remote sensing users, some quietly complained that the study was loaded in favor of the Defense Department and the intelligence community. They seem to have been right. The final policy directive gave a go-ahead for greater control over civilian space activities by the military. Then came publication of the full text of this article. Carter commissioned a new PRM 23 subcommittee to conduct a new study based on the revelations in that article.

Instead of dreaming about LANDSAT becoming immediately self-supporting, we ought to get used to the idea of pumping even more money into the program, improving it, and making the commitment long-term. Only then can remote sensing technology have a chance to fulfill the promises researchers saw 16 years ago. If the money and the technology are not forthcoming, NASA might just as well call in its LANDSATs and divert the funds thereby saved to colonizing Mars or searching for the center of the universe.

David Mathisen will receive his master's degree from the University of Wisconsin–Madison in December 1979. He hopes to work applying remote sensing to environmental impact analysis.

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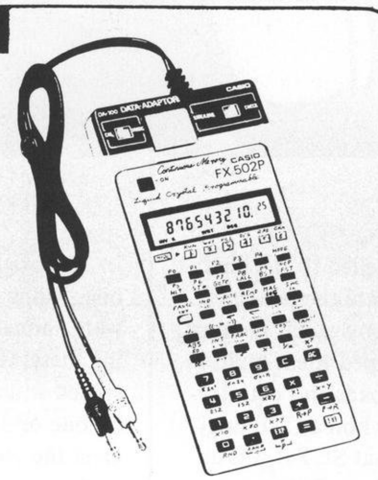

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word search answers

1 St. Patrick
2 Clan
3 Ides of March
4 Shamrock
5 Orange
6 Leprechaun
7 Ireland
8 McCoy
9 Dublin
10 Four leaf clover
11 St. Elmo
12 Gaelic
13 Terrier
14 Engineer
15 Lass
16 St. Valentine
17 Green

Note: The word *squash* was inadvertently left out of the December Word Search.

St. Pat was an engineer

by Nikki Abramoff

One can safely say that to the UW College of Engineering the celebration of St. Patrick's Day is an established tradition. Though the nature of the celebration has varied greatly over the decades, its character remains the same. After all, what would St. Pat's day be without lots of green beer and a little bit of craziness?

The St. Patrick's Day tradition started at the UW around 1915 when the students learned the true story of St. Patrick. The famous patron saint of Ireland was not only a great religious leader, he was also a highly educated engineer and lawyer. After many years of study in England and France, St. Patrick travelled to the land of Erin to aid and educate the peasants there. He defended them against the unjust ruling class and helped them build bridges and chart the roads and countryside. (This would make him a Civil Engineer!) The discovery that St. Pat was an engineer was found to be a fitting excuse for a party during a somewhat dull month, and so the holiday began.

The history of the St. Patrick's Day celebration at the University of Wisconsin is a colorful and glorious one, though some old timers may shudder at the memories.

The original celebration was a tame one. Along with the usual partying, there were annual parades and ceremonies. During these, the "Blarney Stone" was presented and displayed, generally guarded by one or more field artillery pieces. Over the years the rivalry between the engineers and the lawyers, occupying opposing buildings halfway up the Hill, grew. (Engineering was originally located in what is now the Education building.) St. Patrick's day was a focal point of this rivalry since the Irish saint was both an engineer and a lawyer. This competition reached a raucous peak during the 1930's.

Up until a year of no snow, it was traditional on March 17th for the engineers and lawyers to pelt each other with snowballs across the hill. Being resourceful, the engineers came up with a substitute for snowballs–rotten eggs. The first use was limited to the number of rotten eggs available in the area. In succeeding years both sides made sure there was no shortage, and rotten eggs were shipped in from Chicago by the carload. Anyone who walked on the hill that day knew it was St. Pat's day–by the smell. And those who marched in the annual parade were smart to wear plastic overcoats.

The final stroke was executed by the engineers. Early one March 17th, they entered the Law Building, shut off the heat, and hoisted a green "St. pat was an engineer" flag atop the building. Then, to assure many days of waving, they poured drain oil on the tile roof, and chained all the doors as they left the building. When the Dean of the Law School arrived, the engineers, seeing his plight, volunteered to help. One husky engineer (clued in to the lead link in the chain) stepped forward to help them "break in". With several grunts and groans, he snapped the chain and cooly retreated as the great legal minds looked on in awe. After this event a truce was called and a peace treaty was negotiated by the deans. In this pact were prohibitions against barbed wire, tear gas, and rotten eggs.

Since that memorable day, the St. Pat's day celebration has taken on a softer but no less glorious form. In the 1950's and 60's, the St. Patrick's day ball was very popular. A St. Patrick's day king and queen were elected and an Irish beard growing contest was held. In the late 60's the Blarney Stone hunt was the rage, as well as the lawyers vs. engineers basketball tournament, a harmless remainder of the rivalry of old.

This year St. Patrick can be seen around the campus on "St. Pat was an engineer" buttons and T-shirts available through Polygon and Expo, respectively. The annual basketball tournament will hopefully be won this year by a team of engineers (who embarrassingly enough have not won the tournament for several years now). But the high point of the festival will undoubtedly be the St. Patrick's Day all-engineering party to be held this year in the carousel cafeteria on March 15th. Starting at 3:30, an almost unlimited supply (within engineering error) of green beer will be available, the Knights of St. Patrick awards will be presented, and a good time will be had by all. Erin Go Braugh!

Nikki Abramoff is a senior in metallurgical engineering. She is also executive vice-president of Polygon.

College entrance exam

1 SAND	**2** MAN ——— BOARD	**3** STAND ——— I	**4** R E A D I N G	**5** WEAR ——— LONG	**6** R ROADS A D S
7 T O W N	**8** CYCLE CYCLE CYCLE	**9** LE VEL	**10** 0 ——— M.D. PH.D. B.S.	**11** KNEE LIGHTS	**12** I I I ——— O O
13 CHAIR	**14** DICE DICE	**15** T O U C H	**16** GROUND ——— FEET FEET FEET FEET FEET FEET	**17** MIND ——— MATTER	**18** HE'S/HIMSELF
19 ECNALG	**20** DEATH/LIFE	**21** G.I. ——— C C C C C C	**22** ___ PROGRAM	**23** J YOU U ME S T	**24** B L O U S E

Answers on page 30.

A change of place

international engineering programs

by Ken Kusel

If you are tired of trudging through knee-deep snow to make a 7:45 lab on time, consider studying in the sun next winter. A unique cultural and educational opportunity for engineering undergraduates is offered to qualified students through the University of Wisconsin–Monterrey Tec Program.

Students at the University of Wisconsin–Madison, College of Engineering who are U.S. citizens may qualify. You must have completed at least one year of college level Spanish language study during your sophomore year and have a grade point average of approximately 3.0 or better to be eligible for this program.

The junior year of study for an engineering degree is spent at El Instituto Tecnologico y de Estudios Superiores de Monterrey in Monterrey, Mexico. More commonly referred to as Monterrey Tec, the institution is known throughout Latin America (as the "M.I.T. of Latin America") for its outstanding technical education. The course of study is carefully reviewed so that students participating in the program are in step with their curriculum upon returning to school in Madison. All credits taken at the Tec are transferable. Because classes are conducted in Spanish, American students take an intensive six week language study at the Tec in the summer, just prior to the academic year of studies.

The Tec is located on the edge of Monterrey, Mexico's third largest city with one million inhabitants, and is an important industrial and trade center. Frequent industrial visits are planned to supplement the student's classroom activity. Participants are housed in modern dormitories on campus with roommates from all over Latin America. Ample time and opportunity permit the student to travel throughout Mexico, and students are strongly encouraged to participate in local cultural activities as well.

The cost of the program is approximately the same as for an academic year in Madison, plus an additional 500 dollars for spending money. The University pays round trip travel expenses as well as some of the expenses of planned vacation trips.

Since the beginning of the program in 1961, over 100 participants have had the opportunity to study at Monterrey Tec. Similarly, many Tec students have studied on the Madison campus.

Further educational-travel opportunities are available to qualified students wishing to study their junior year in Germany. Several locations are available in Germany depending upon your major field of study in Engineering. The language requirements are more stringent, however, requiring two years of college level German language study. Students must pay their own travel expenses, and other expenses may vary with location. Some reimbursement for this program is possible.

If you feel you are qualified for either of these programs, would like to talk to former participants, or have any questions, you may contact Mrs. Bonnie Kienitz in the International Undergraduate Engineering Programs office in 737 Engineering Research Building for further information.

Ken Kusel is a senior in mechanical engineering. He plans to attend law school or do graduate work in engineering next year.

Photo by John Wardale

Bonnie Kienitz, coordinator of International Engineering Programs, helps "orient" interested students.

The Library at Monterrey Tec; Monterrey, Mexico

polygon:
your student engineering council

by Nikki Abramoff

Polygon's new executive board promises to sponsor a multitude of activities this spring semester.

The biggest? St. Pat's Day, of course.

Held on Thursday, March 15, in the Carousel Cafeteria in Union South, the festivities will last from 3:30 to ? p.m. There will be plenty of green beer on hand and lots of fun. (See story on page 24 for a brief history of the St. Pat's Day festivities).

Students interested in becoming directly involved with Polygon should consider applying for membership as "student-at-large" members. Applications will be taken at the end of the semester.

Grant Dekker was initiated as our new student-at-large member in January.

Our new executive board members took office in December:

President–Daniel Zietlow
Executive Vice President–Nikki Abramoff
Administrative Vice President–Diana Denzer
Secretary–Delores Malloy
Treasurer–David Weisberg

The Polygon Council exists to serve the engineering student body. If you have any suggestions or questions, contact us. You can drop a note in our mailbox in the Mechanical Engineering lobby, drop in at our office, Room 23, General Engineering, or contact Dan Zietlow at 274-2788.

Nikki Abramoff is a senior in metallurgical engineering. She is also executive vice-president of Polygon.

Earn while you learn

co-operative education program

by Kathy Howard

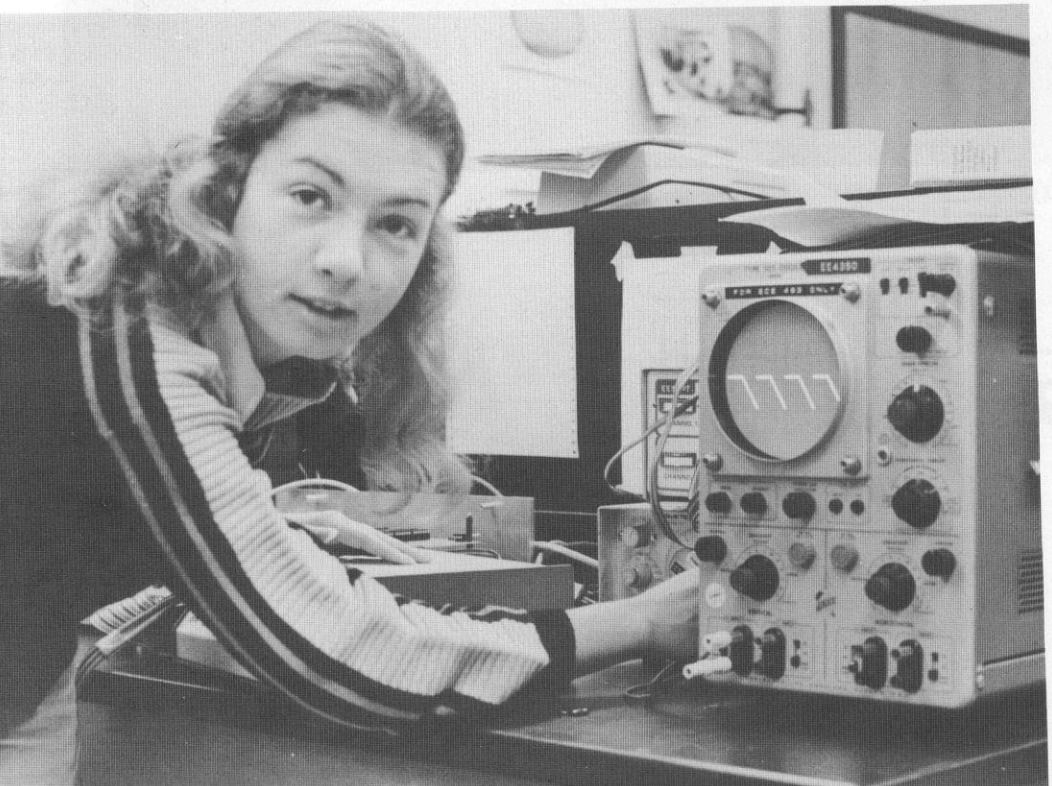
Madison is a co-op city: it has everything from co-op food stores to co-op bicycle shops and drugstores. On the engineering campus, co-oping has a different meaning altogether. It is a great way to get some valuable work experience and earn some money while pursuing your degree.

One way to co-op is to alternate semesters of work and study. The student does just that; attends school for a semester and then breaks away into the "real world" of work for a semester. This seems to be the most popular.

This type of co-op has its advantages and disadvantages. In any given semester, you will have worked the previous one, so you are seemingly "always in the bucks". However, you will pay for this by spending extra years to get your college degree. Those of you who would like to finish school in four years should plan to extend your college career to a total of about five years. For the people on the five-year plan, who knows how long you'll be in Madison? Another disadvantage is that if your semester of school work happens to occur during the summer, you stand a poor chance of being able to take the courses you need due to limited summer school course offerings.

The other way to co-op is to work during the summer. This allows the student the opportunity to work and gain experience, but doesn't add the extra years that the alternating pattern of work and study does.

Photo by Bill Held



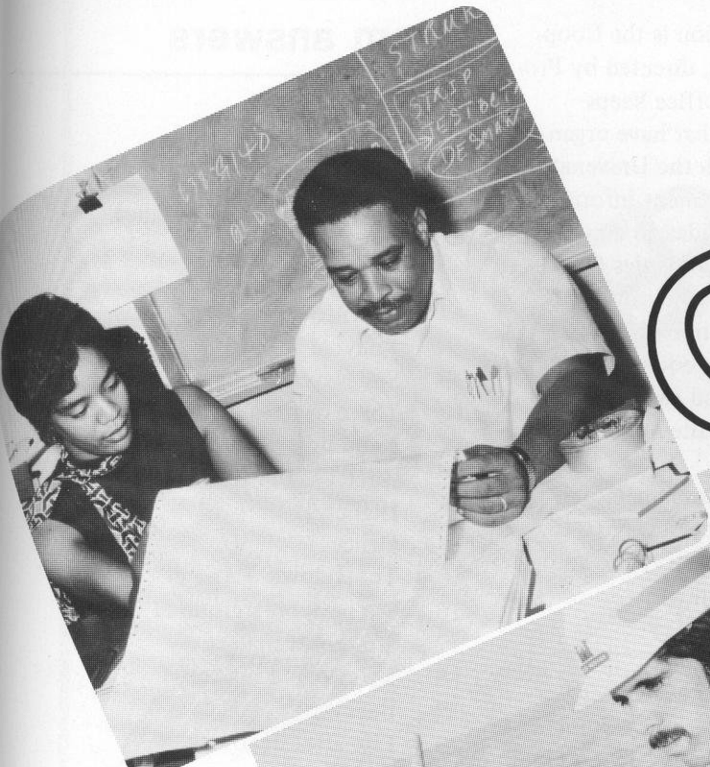
Kathy Howard tries to get an oscilloscope to cooperate.

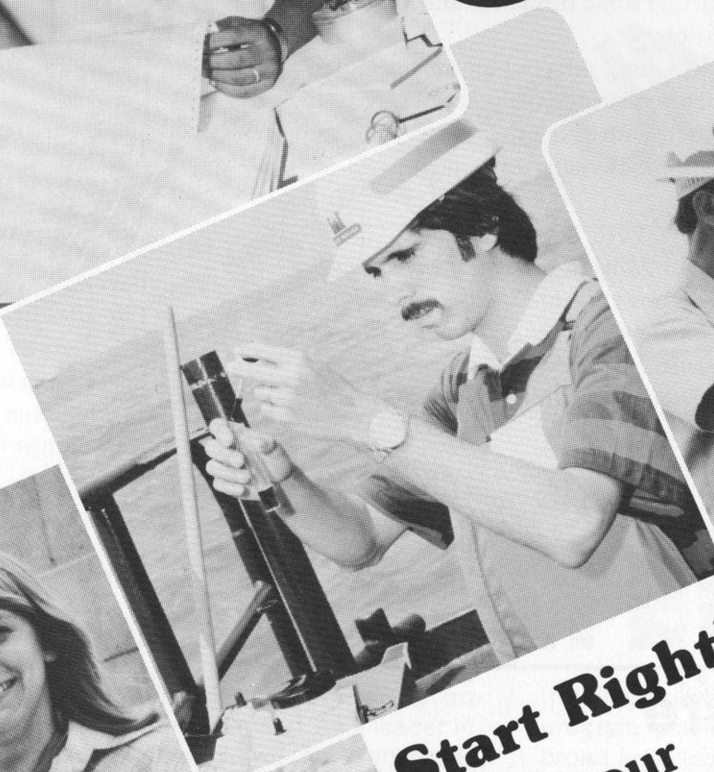
What advantage is there to co-oping over just working for a summer or a semester? The difference is that when you are part of a company's co-op program you are practically guaranteed a job when your next period of work comes around. However, the company may require a student to maintain a certain grade point to enter the program, and then require that he or she maintain it during employment. Different companies will have varied requirements for their co-op students. If you get a regular summer job, one which is not related to a co-op program, there are no guarantees of returning the next summer you want to work.

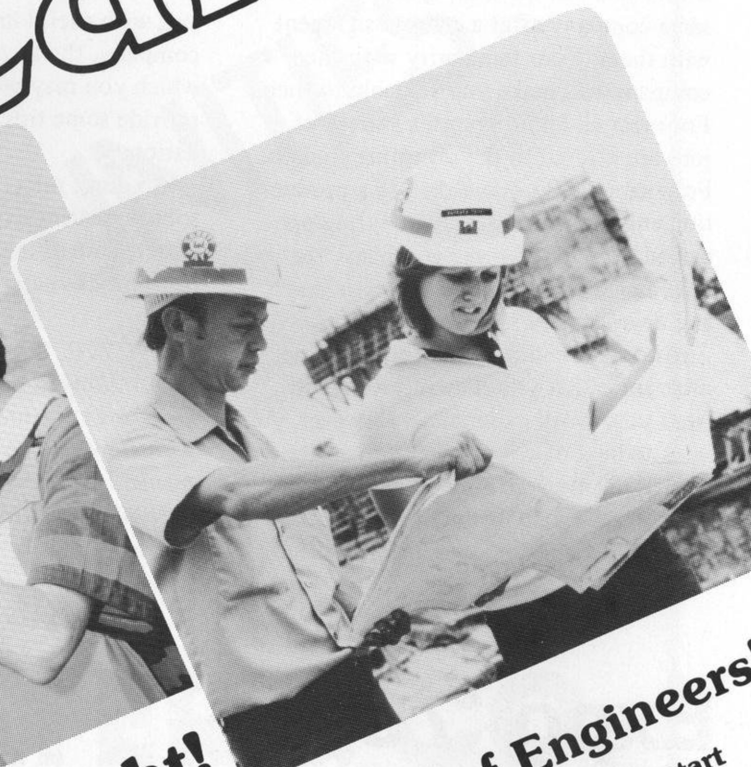
Company benefits are usually extended to both students on a co-op program and those that are not. Medical and, sometimes, dental insurance is included.

If your potential co-op job is not a local one, you will have to consider a move to "foreign territory." For the most part, you aren't offered plant trips to see the prospective territory. Such privileges are reserved for graduating seniors. This means that if your employer has no housing program for its co-op students, you

Careers







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will have only a few days in which to find your own housing in a strange city. Various parts of the country have different costs of living indices, so beware! For example, residing in the San Francisco area is likely to be more expensive than living in Madison for the summer.

One of the positive points of co-oping is that you can quite likely return to the same company after a co-op assignment with them. Your familiarity with the company will make you valuable to them. For most co-op programs, a variety of jobs are offered to the returning student. For example, if you worked in a production engineering atmosphere during one period of work with the company, the next assignment could be in the research and development lab.

Another benefit of the formal co-op program is that you may receive credit from your work experience. However, you must write a report of what you accomplished during your time of employment in order to obtain one credit.

So, where do you sign up? The place to gather some information is the Cooperative Education Office, directed by Professor George Sell. The office keeps track of the companies that have organized co-op programs with the University and can give you the pertinent information. It might be a good idea to contact past employees of the companies who are on campus. These people can furnish you with useful information about the company, the area of the country in which you may work, and can possibly provide some tips about the housing situation.

So don't miss out on a chance for some excellent experience, a way to contribute something to industry, and an opportunity to earn some money.

Kathy Howard is a senior Electrical Engineering student. She is a co-op student with Hewlett-Packard in Palo Alto, California. Her work experience there has been in production engineering and marketing.

exam answers

1 Sandbox
2 Man overboard
3 I understand
4 Reading between the lines
5 Long underwear
6 Crossroads
7 Downtown
8 Tricycle
9 Split level or bilevel
10 Three degrees below zero
11 Neon lights
12 Circles under the eyes
13 Highchair
14 Deuce
15 Touchdown
16 Six feet underground
17 Mind over matter
18 He's behind himself
19 Backwards glance
20 Life after death
21 G.I. overseas
22 Space Program
23 Just between you and me
24 See through blouse

Expo '79

an eye on the future

EXPO '79 is here.

It's time to get involved with the 1979 Engineering Exposition if you haven't done so already.

Scheduled to take place on April 27, 28, and 29, 1979, this biennial spring event offers engineering students the opportunity to apply their knowledge, become involved, and even earn credit for developing an Expo exhibit.

If you aren't interested in exhibiting, the Executive Committee can always use more help with preliminary planning. Although planning for EXPO began in October, 1978, there is still an enormous amount of work to do before April.

As with EXPO '77, any profits from the Exposition will be distributed to those organizations that will assist in the production of EXPO '79. To be eligible for these funds, an organization need only meet certain requirements set by the Executive Committee. Details of the amount of work required from an organization will be distributed to all engineering organizations.

Individual awards are also available to individuals unassociated with an organization who exhibit in EXPO '79. For more details, contact Grant Dekker or Pat Gureski at the EXPO office, Room 1142 Engineering, 262-6842.

Also returning this spring are the EXPO '79 T-shirts and buttons. Don't miss the limited edition T-shirt designed especially for EXPO '79. This shirt is kelly green with a leprechaun and the words "St. Pat was an Engineer" printed on the back. Get yours soon because they won't last long.

Don't delay. Get involved today for EXPO '79 is approaching fast.

Pat Gureski is a senior in mechanical engineering. He and Grant Dekker are cochairmen of Expo '79.

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INTERVIEWS ON CAMPUS

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Some of the members of this group found a bachelor's degree was all that was needed to prepare them for a challenging job. Other positions are better suited for someone who has completed a master's degree. If you prefer to work now and study later, the Kodak Educational Aid Program offers opportunities for full- or part-time learning. Those bent on a career in research usually apply to us with Ph.D in hand.

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We're looking for people who are looking for a real job. One that offers challenging work. Responsible work.

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At GE, you'll be handed important assignments right from the start. You can do as much of the job as you're capable of doing. If you need help, it's there. If not, nobody butts in.

Here's the kind of thing we're talking about; some recent examples of jobs handled by new GE engineers:

1. *Charles P.* Aerospace systems manufacturing. Develop and document a direct numerical control system.
2. *Steve O.* Design engineering. Design test equipment for attitude control system of new communications satellite.
3. *Norma L.* Steam-turbine manufacturing. Investigate, analyze and obtain funds for solution of shop problems.
4. *Stephanie B.* Medical systems service engineering. Installation and test of new hospital radiographic and fluoroscopic x-ray system.
5. *Mel D.* Field engineering. Appraisal load testing of low and medium-voltage switchgear and power transformers for utility and industrial applications.

There's a good reason GE hands people like that—like you—real work assignments. It's the best way to develop the skills you will need throughout your career. You develop initiative and creativity. And responsibility. And GE also knows there's little to match the glow you feel when you make an important contribution.

You can make your contribution in just about any field of engineering at GE. We're that diversified in disciplines.

If you like the kind of challenge and responsibility that GE offers, we'd like to hear from you. Send for our free careers booklet. Just write:
General Electric, Educational Communications, WID, Fairfield, Connecticut 06431.

Progress for People

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