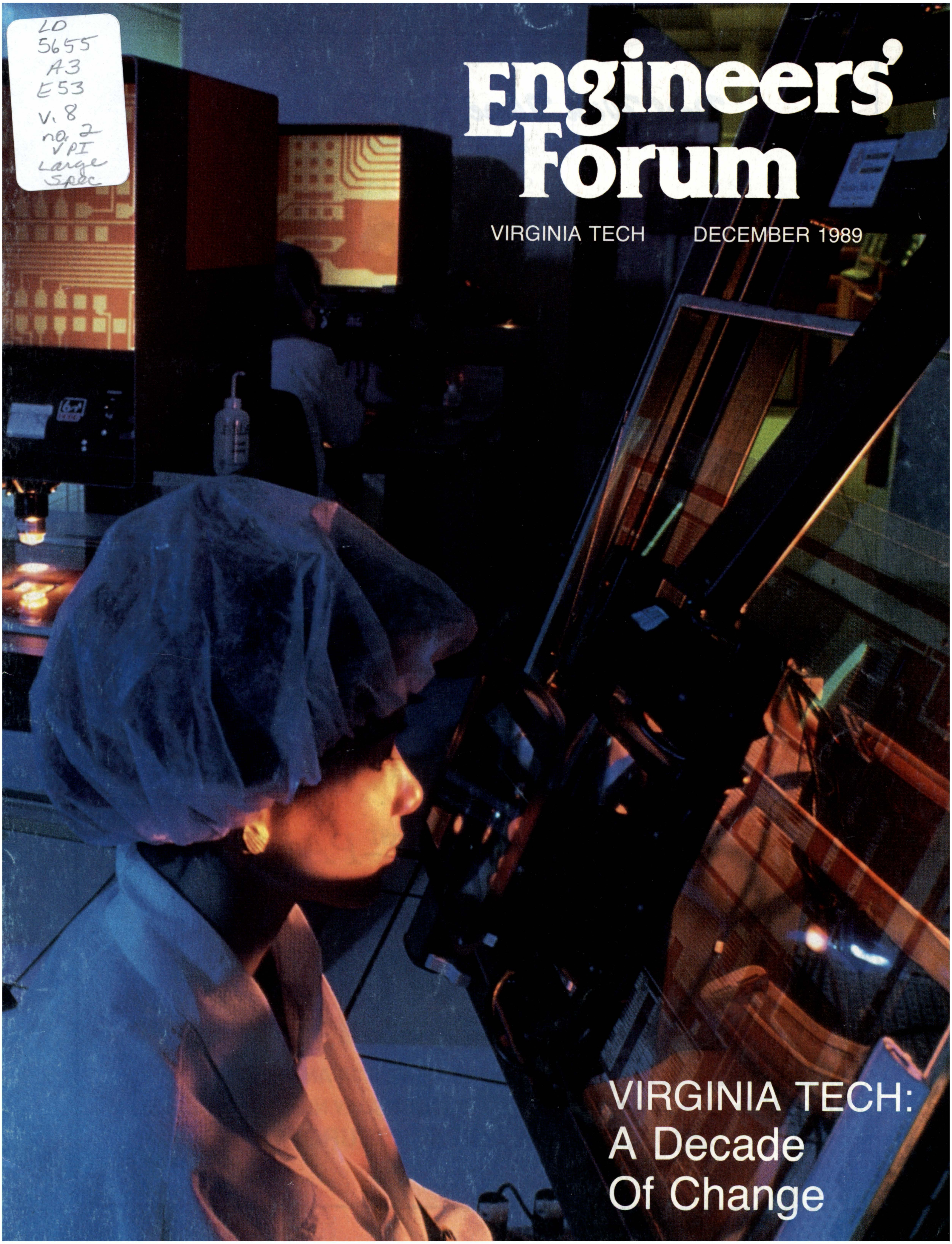

Engineers' Forum

VIRGINIA TECH DECEMBER 1989

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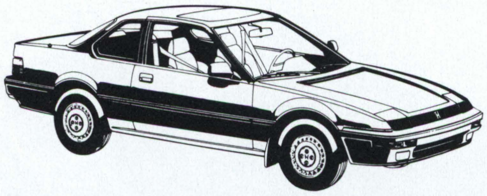

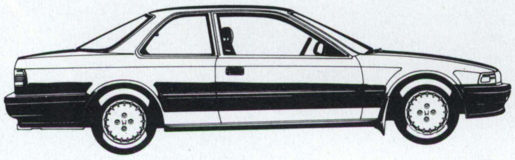

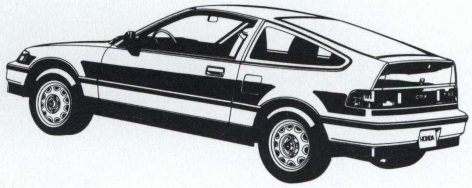

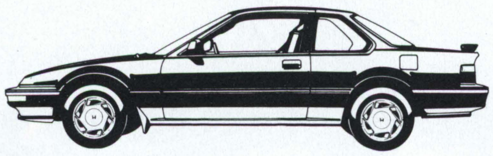

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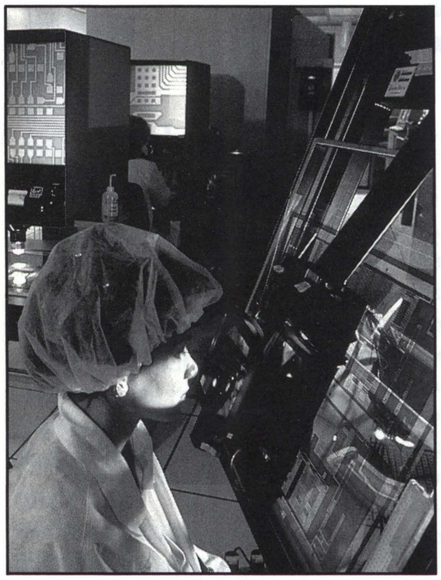

ON THE COVER

Engineers' Forum looks back at the past 10 years of progress in the College of Engineering and focuses on the strengths that will carry over into the next decade.

VOLUME 8
NUMBER 2
DECEMBER, 1989

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Engineers' Forum

Engineers' Forum is Virginia Tech's student engineering magazine. *Engineers' Forum* magazine is published four times during the academic year. The editorial and business office is located at 112 Femoyer Hall, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. Phone (703) 231-7738. Member of Engineering College Magazines Associated, Lynn A. Nystrom, Chairperson.

Darkroom facilities donated by Virginia Tech Communications Department.

EDITOR'S PAGE

The Importance of Engineering Judgement

The tragic earthquake that struck California in October served to illustrate the important role engineers often play. Structural engineers were called upon to decide whether it would be safe to go into the unstable wreckage of Interstate 880 and rescue entrapped motorists. This was a life and death situation: if rescue workers did not go into the wreckage, injured people would die; but in attempting to save them, rescuers put their own lives, and the lives of the people surrounding the teetering structure, at risk (especially if an aftershock were to occur).

The decision obviously needed to be made rapidly, without time for a meeting or computer simulation or other folly. The decision had to be made using engineering judgement. The importance of such judgement cannot be overstated. Engineering judgement is decidedly the most important tool of the engineer's trade.

Yet for all its importance, engineering judgement is not something that can be taught. You won't find a course on engineering decision-making anywhere in the VPI&SU catalog. Rather, judgement is an authoritative decision-making skill developed in two significant but separate areas.

Without a doubt, this skill is developed in an area common to us all, engineering education. Beginning with the fundamentals of free body diagrams in Statics, the foundation for technical expertise is laid. This construction of knowledge is not disjoint and unorganized; instead, it is more like a pyramid. The first levels are broad, consisting of the essential science and mechanics classes common to all engineering disciplines. The middle levels of the technical pyramid are smaller, comprised of elementary courses in the key areas of the discipline.

The design and specialized 4000-level courses of the senior year constitute the top of the pyramid. The beauty of this educational architecture is that the middle and especially upper levels — levels which make up an area of emphasis — are determined by the student. With concentration on a particular area of interest, a degree of technical expertise in that field is achieved. Advanced degrees represent a higher level of technical proficiency. This expertise is the technical background required to make an engineering decision.

The development of engineering judgement is also closely tied in with personal character growth. Critical decisions necessitate both a personal maturity and strong sense of morality. In other words, a hyperactive five-year-old (or twenty-five-year-old) should not be making potentially life-altering decisions; nor should an engineer who places the almighty dollar above human life. The development of personal integrity begins in childhood, and is largely influenced by family and peers. Values that are established at an early age carry on to influence judgement as a practicing engineer.

Engineering judgement, then, brings together technical knowledge with personal standards. Judgement without either would unquestionably be disastrous. Granted, not every engineer will ever work on a project with potential harm to humans. The judgement used in making any technical decision will likely involve ethics: adherence to standards, avoidance of patent violations, etc. The engineer who has developed a good sense of judgement will succeed anywhere.

Now place yourself in the shoes of a structural engineer inspecting I-880 in California last October. Your only tool in the field is your engineering judgement. Would you be able to decide what to do?

Andrew E. Stalder
Editor

EF LETTERS

Our Friend Dean

Why does your magazine persist in referring to the head of the College of Engineering as DEAN Torgersen when his real name is PAUL?

Yours Truly,
Landru M. Gumby
Computer Engineering

'Dean' is a nickname Torgersen picked up some twenty years ago and it's stayed with him ever since. He's even gotten used to it. — Ed.

Easy Lifetime Payments

Engineering courses and professors should get their act together. For the past three semesters, I have paid out the usual $200-$250 for books and supplies when classes started, only to find that the buck didn't stop there. Professors are getting into the infuriating habit of asking students to shell out another $30 to $75 for additional course notes, texts, and software at midterm. To the student on a budget, these unexpected costs are more than an inconvenience. Professors owe students the respect of announcing all materials that will be required during the semester instead of surprising them with added expenses at mid-term.

S.T.
Junior,
Mechanical Engineering

Worse still are the cases when a piece of software is announced as required, and then never touched during the semester. If the student was unfortunate enough to open the protective seal around the software package, surprise — he's now the owner of that useless software for life. — Ed.

Forum Swimsuit Issue

For the last few years, I have watched the development of the *Engineers' Forum.* I think a format change is necessary and long overdue.

Instead of the same old boring technical articles, how about some human interest features? You could do something on the latest engineering fashions — "Plaid Pocket Protectors: Is the Establishment Ready?" or "Wearing Matching Clothes: A Guide for Beginners." There is a vast, untapped wealth of story ideas.

Why not include articles targeted toward specific groups? What faculty member would not read "Teaching Your Pets FORTRAN 77" or "Coping With the Non-Engineers in Your Family?" As for students, I can think of nothing better than a semester guide that rates courses and professors. Such a service would boost readership tremendously.

The one change that should be foremost in your minds is the publication of an *Engineers' Forum* Swimsuit Issue. Seeing Paulina Porizkova (or Patrick Swayze for the ladies) wearing little more than a lab manual would indeed be a warm addition to the Blacksburg winter!

E.D.
Engineer in Development

Models' fees being what they are, we would have to charge readers a subscription fee of $19.95 for 52 weeks (four issues) of the Forum. But of course, we'll throw in a digital clock radio absolutely free. — Ed.

TODAY's Story

I am so SICK of engineering, and the petty NONSENSE that goes on within our college that I could THROW UP. All the tests that make you feel worthless and the everyday BULL____ that goes on in class could drive even the sanest person over the edge. However the "weeding out" process is a fact of life and we must accept it. For this very reason, I plan to forget all about engineering and concentrate on the finer things in life — like television — specifically the TODAY show.

If you didn't know, a new member has joined the regular team of Bryant Gumbel and Jane Pauley, and her name is Debra Norville. I hear that she is being "groomed" to take Jane Pauley's place. If this is true, the show's producers must be crazy.

Just because a pretty face with an air of self-confidence comes along, it does not mean you replace a veteran reporter. Pauley has been on the show for a long time, and she is a damn good reporter. So what if she's 34 years old or so — since when did age become the deciding factor of good reporting? Besides, she still looks good. Far be it from me to pass judgement on such an American institution, but I think replacing Pauley with Norville is "brain-dead."

But this *is* television and Norville is a "VERY NICE" young woman and that's what counts. Bet she won't show any age after she has been getting up at three a.m. for ten years like Pauley has. After all, she is Debra Norville, and that just about does Jane Pauley in.

Fed Up With Engineering
(Somewhere on Tech's campus)

SEC NOTES

On E-Week, Space, and Cookies

By Kendall Giles

This is a new column to the *Engineers' Forum* and it will be a regular feature forever-more. Its purpose is to bring you some news from the Student Engineers' Council and the College of Engineering, in case you missed our meetings. To find out more information about the SEC and its activities, call the office number at the end of this article.

EXPO '89 was a big success again this year. We had 113 companies attend and there were five student organization booths. There was even a nuclear reactor and a mock Three Mile Island meltdown, courtesy of Virginia Power. The representatives really enjoyed meeting with the students and there were many resumes passed by employee hopefuls.

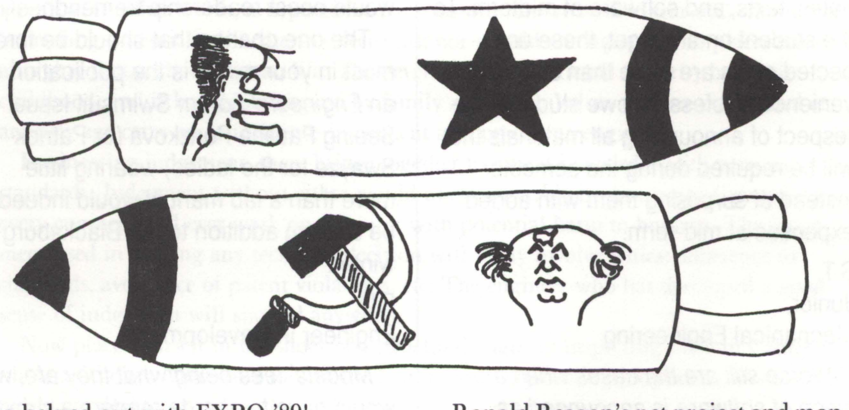
On October 28 we held the First Annual SEC Tailgate, right before the Tulane game. There was a lot of food and beverages, including a very special cherry punch, which gave me the strongest sugar high I had had in awhile. If you missed out, you really missed out.

Our next big project is Engineers' Week, which is February 18 through February 23, 1990. We are trying to come up with a wide variety of fun and interesting events that everyone would enjoy. A tentative list so far includes a dance, a volleyball tournament, Engineers' Choice, a speaker, a student/faculty luncheon, Open House, and an E-Week Happy Hour/Awards Ceremony (more punch!). We want to fill up E-Week with a lot of events, because this is the chance for engineers to shine and have some fun, for a whole week. If you have any ideas or want to help, let an SEC officer know or attend the next meeting.

Just recently, six representatives from the SEC attended the National Student Engineers' Conference, which was held this year at the University of Cincinnati. It lasted for four days and there were engineering students from across the nation in attendance, including one individual from the University of Hawaii. It was a good chance to meet students from other schools to see how their engineering programs and their Student Engineers' Councils differed from ours. One thing that everyone here at Tech should be proud of is that our school has one of the strongest Student Engineers' Councils anywhere. We are one of the most active councils and our EXPO was the main feature at Roundtable discussions with other schools. Good job for all those who helped out with EXPO '89!

We also heard two speakers, Dr. Joseph P. Allen, retired astronaut and President of Space Technologies, and Patrice Adcroft, editor of *Omni* magazine. Their talks were both interesting and inspiring, as they focused on the role that today's engineers (us) will have in the future growth and safety of not only our country but also of our planet as well. A few points were brought up that I feel we should keep in mind as we apply our knowledge once we graduate and enter into the work-world.

There are presently 60,000 nuclear warheads on Earth. That's 60 giga-tons of TNT. If you consider that the total explosive force in World War II was only 3 mega-tons, you can really appreciate how worried the Europeans are right now, who lie right in the middle of the United States-Russia pie-throwing zone. Though tensions are easing and change appears to be wreaking havoc within the communist block, presently there still exists five tons of TNT for every man, woman, and child.



Ronald Reagan's pet project and money-sink, Star Wars, is constantly being debated by the "It Can Work, Tastes Great" camp and the "It's Not Possible,

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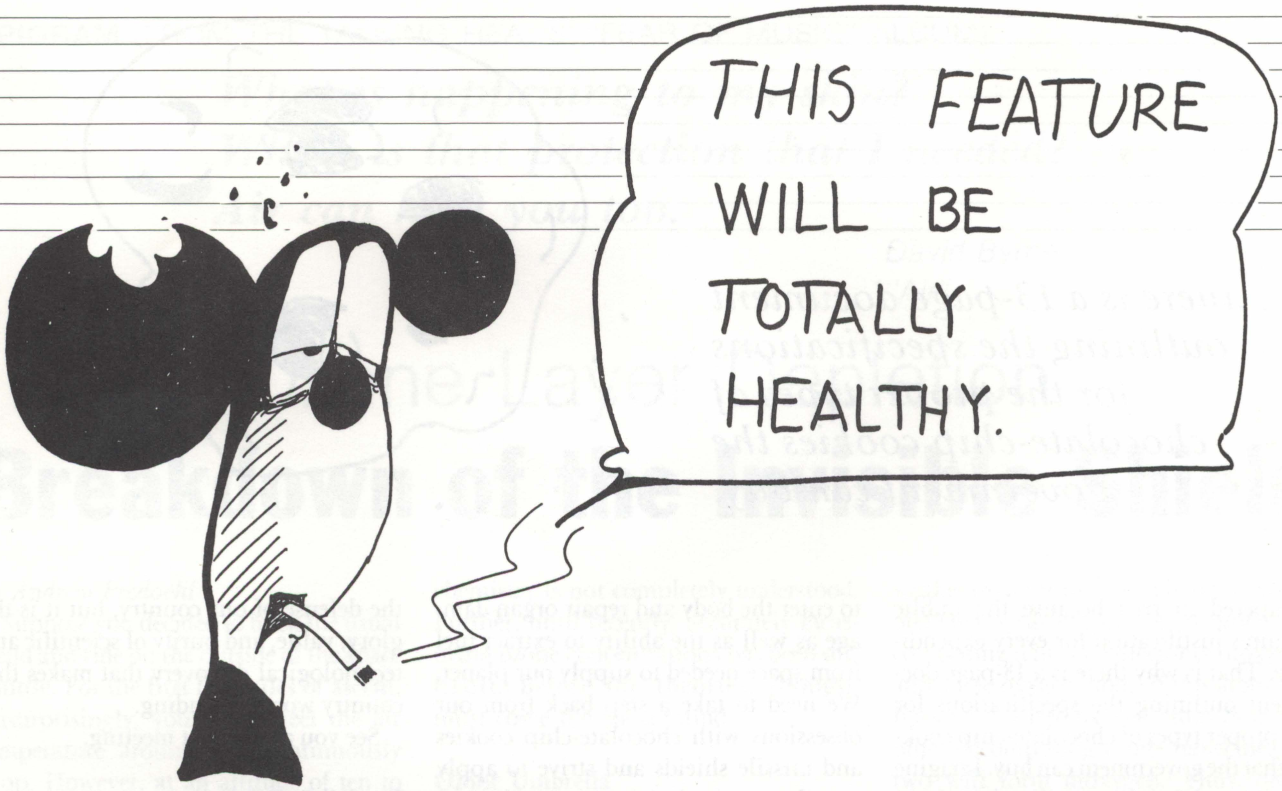

Less Filling" bunch. If they want this defense system to work, they are going to have to come up with a rather ingenious laser station because I don't think anyone can provide the 10 billion watts of power needed to cut through the atmosphere to the reflecting satellites from a ground based system. That would take some pretty straight shooting to hit the speeding rockets in the right place for a sustained length of time in order to render the missiles incapacitated. Also, imagine what a downer it would be to have several nuclear warheads explode in the atmosphere above your house. Above your city. Above your country. You would definitely have a bit more to worry about than the nearest hole in the ozone layer.

Yes, William Shatner was right. Space is the final frontier. There are opportunities and worlds unlimited in size and scope just waiting to be discovered. Yet here we sit, our government mired in red tape and general apathy. Basically, there is an impedance mismatch between the buyer (the government) and the vendors (industry). Already we lag behind France and Germany in the commercialization of space. Japan and several other countries are ready to pass us by as well. The government just does not want to commit to a real decision — it acts on long decision cycles. Industry, however, must act on short decision cycles because of rapidly changing technology. In the early seventies, a real decision was made that we need to get our act together and build ourselves a space station. Five years later Skylab was in space. In 1984, a semi-decision was made that we need a new space station. Here we are, five years later and absolutely nothing to show for it, except for lots of bills. (The expected date of the space station is approximately 2000 A.D., but don't hold your breath).

I don't know what else to say to inspire you to action, to make a difference in the jobs you do as engineers. Today we have the knowledge to repair and extend life, to patent new genes, and to annihilate the Earth. The Agricultural Revolution (nomads, pottery, and such) was first. Then came the Industrial Revolution where we were graced by the steam engine, railroads, steamships, and gas lighting. In the early 20th century we exploded into the Information Revolution where computers (the first computer was built less than 40 years ago), satellites, and packet radio allow us to gather data with the ease of the flick of a switch. More information has been produced in the last 30 years than in the last 5000. The total amount of information we have gathered doubles approximately every 8 years. NEC is working on a new supercomputer capable of 22 billion floating calculations in one second.

Face it. We are in the midst of exciting times and, as engineers, we have the knowledge, responsibility, and ability to work wonders. We just lack resolve. As Buzz Aldrin painfully points out, the Soviets will reach Mars before we set foot on the moon again. But don't put all the blame on the White House. They are

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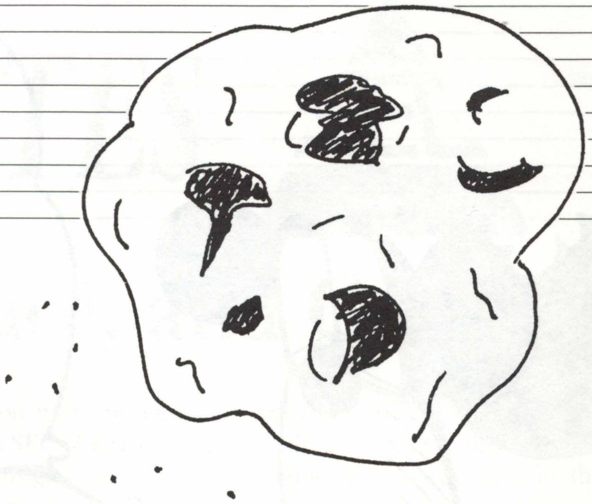
...there is a 13-page document outlining the specifications for the proper types of chocolate-chip cookies the government can buy.

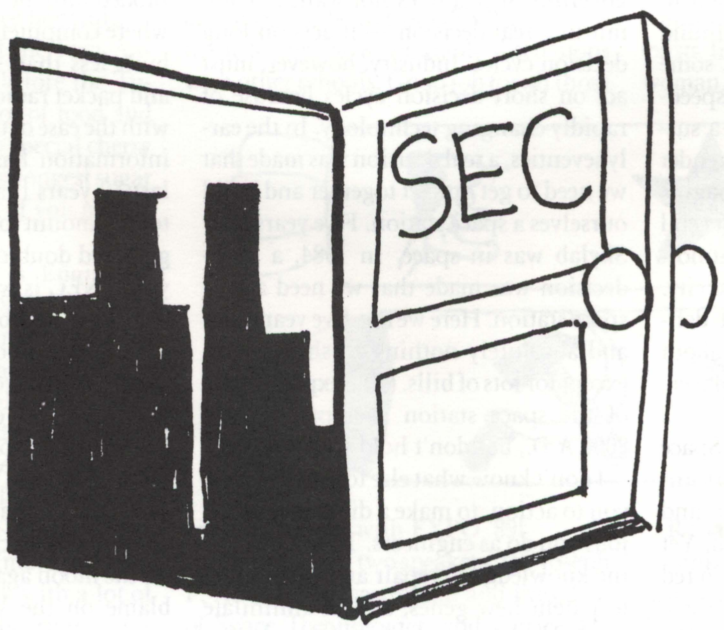


hampered in part because the public requires justification for every expenditure. That is why there is a 13-page document outlining the specifications for the proper types of chocolate-chip cookies that the government can buy. Imagine the manual for the specifications for a vehicle to take humans to space!

Science and technology is the key to the present and to the future. We have the capability of designing micro-machines to enter the body and repair organ damage as well as the ability to extract fuel from space needed to supply our planet. We need to take a step back from our obsessions with chocolate-chip cookies and missile shields and strive to apply ourselves towards less petty and more worthy goals. But first we must get up off our apathetic bottoms. There is so much wonder and adventure waiting to be sampled. Yes, we do need to worry about the defense of our country, but it is the glory, value, and purity of scientific and technological discovery that makes this country worth defending.

See you at the next meeting.

Kendall E. Giles
President, SEC
Office: 110 Femoyer
231-6036
Also check under Norris tunnel.



EPIGRAM (FROM THE TALKING HEADS' "FEAR OF MUSIC" ALBUM):

What is happening to my skin?
Where is that protection that I needed?
Air can hurt you too.

David Byrne
"Air"

Ozone Layer Depletion
Breakdown of the Invisible Shield

by Andrew Predoehl

Suppose you decided to buck the usual trend and ride on the outside of the space shuttle. For the first few miles of ascent, unsurprisingly, you would feel the air temperature around you continuously drop. However, at an altitude of ten to fifteen miles, you would begin to notice (were you still conscious) the temperature noticeably rise; you would smell an acrid odor and feel your eyes burn. You would experience firsthand the ozone layer.

Ozone is oxygen in a form quite unlike the breathing kind. At an altitude of about ten miles ozone accounts for over 25% of the mass of the atmosphere, and it is a product of and absorber of destructive ultraviolet (UV) energy. This ozone — stratospheric ozone — and the ozone found in smog are the same chemical compound, but the two are formed by different reactions, and only one is beneficial to life. Ground level ozone, known as tropospheric ozone, destroys chlorophyll and corrodes lungs. It is a serious urban pollutant, and nobody would protest if tropospheric ozone inexplicably began to disappear.

Unfortunately, it is stratospheric ozone that has been vanishing mysteriously for the past few decades, and nobody definitively knows why. The theories are easy to propose but nearly impossible to prove, because high-altitude atmospheric chemistry is not completely understood. Further, until recently, accurately measuring ozone concentrations has been difficult. Before the theories, though, must come the background.

Ozone Umbrella

Gaseous oxygen is usually found in diatomic form, the familiar O_2, called dioxygen. Dioxygen reacts easily with other chemicals, of course, but under normal conditions it will not spontaneously decompose into its two oxygen atoms. When a dioxygen molecule absorbs a photon of ordinary visible light, it merely heats up; the chemical bond between the two oxygen atoms is fairly strong, and a photon from, say, a light bulb simply lacks the energy to break that bond. However, high in the atmosphere, sunlight shines unfiltered through space, showering the earth with visible light and with high-energy UV photons, which possess much more energy than do visible light photons. When a stratospheric dioxygen molecule absorbs UV radiation, the dioxygen bond is shattered — the molecule splits in half, producing two single oxygen atoms, which are extremely reactive. These atoms each grab a molecule of dioxygen to form ozone (Figure 1, page 8).

Ozone is much less stable than dioxygen; that is, the ozone bonds are much weaker than the dioxygen bond. Ultraviolet energy easily splits apart ozone, decomposing it into a molecule of dioxygen and a free oxygen atom. If this atom collides with a free oxygen atom from another decomposing ozone molecule, the two will form dioxygen. Thus, ozone forms an equilibrium of formation and decomposition shown in Figure 2 on page 9.

How does this cycle help the world below? Each reaction absorbs UV radiation, in decomposing both dioxygen and ozone. The energy in the equilibrium starts as UV photons and ends up as heat, heat (equal to the absorbed UV energy) released when an ozone molecule decomposes. Thus, the cycle endlessly converts UV photons to heat. These basic reactions are complicated by a host of other reactions that control ozone, since the atmosphere quite naturally contains more than oxygen.

The form of UV radiation that ozone filters is destructive to life; as everyone knows, it causes skin cancer in humans, such as the infamous and usually-fatal malignant melanoma, as well as other carcinomas. A National Academy of Science (NAS) report indicates that UV radiation also may affect the immune system of animals and humans. Nobody can predict precisely the long-range results

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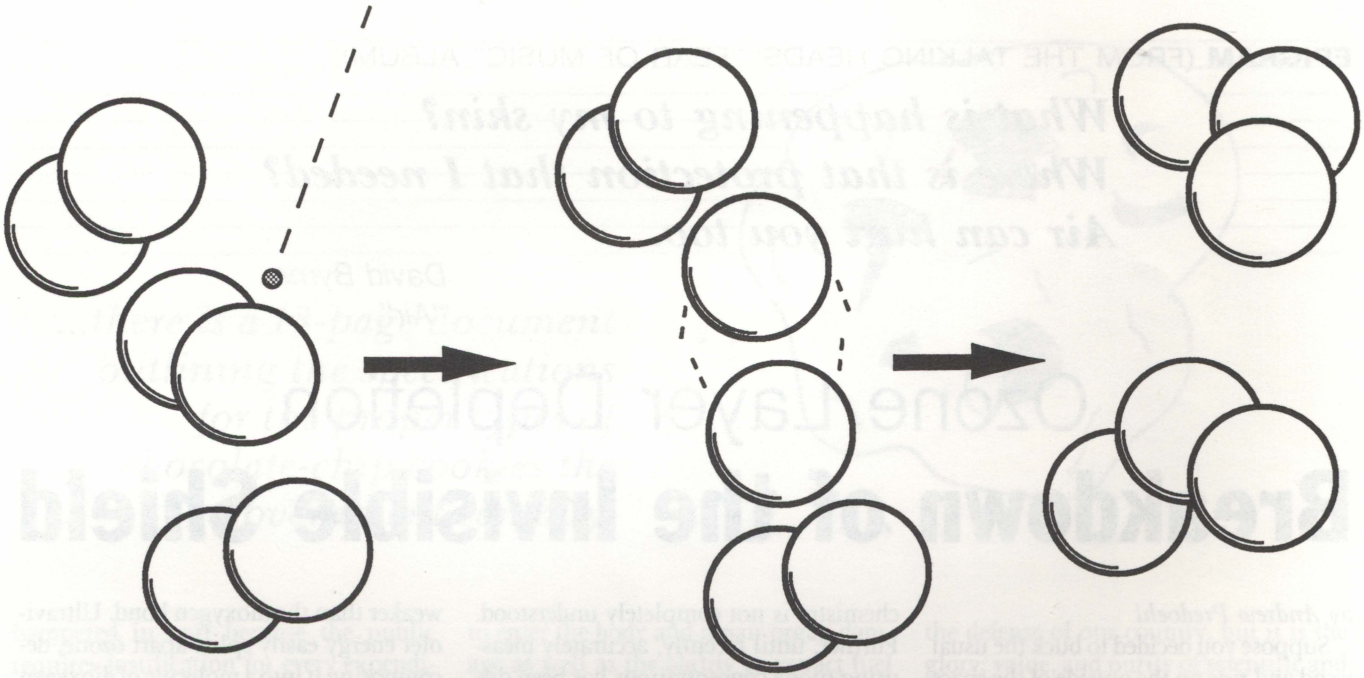

FIGURE 1. An ultraviolet photon splits O_2 into oxygen atoms, which form ozone.

of increased UV radiation, since the effect will be sweeping, affecting animals, microbial life, vegetation, soil, ocean algae, crop harvests, and tropospheric climate, all of which play complicated interdependent roles in the environment.

Killer Deodorant

Of course, the environmental issue is that data indicate the ozone layer is thinning, and a solution requires understanding the cause. Ozone depletion has been noted as early as 1958, although it was thought a result of the sun's fluctuations. In 1974 the ozone layer grabbed the spotlight when two California scientists, Mario Molina and Sherwood Rowland, proposed that ozone depletion is caused by chlorofluorocarbons (CFC's) decomposing in the stratosphere. The Molina-Rowland theory so dominates the field that people involved with ozone often forget that other theories exist; also, their theory is the only one that blames ozone loss on pollution, specifically, CFC pollution.

Chlorofluorocarbons are man-made chemicals useful in thousands of industrial applications because they are non-toxic and unreactive under normal conditions. Molina and Rowland state that CFC's are so unreactive that they survive long enough in the atmosphere to diffuse into the stratosphere; such diffusion is notably slow since there is little vertical air movement that high (clouds and rainfall, for example, occur in the troposphere). At that altitude, the harsh UV rays break down the CFC molecules into highly reactive pieces, specifically, chlorine atoms and chlorine monoxide (ClO) molecules.

Molina and Rowland cite these two chemicals as the principal ozone killers: the atomic oxygen needed to form ozone instead reacts with chlorine monoxide to produce chlorine atoms and dioxygen. Each chlorine atom then tears an oxygen atom from an ozone molecule, forming chlorine monoxide and more dioxygen; the reactions repeat, since the chlorine monoxide restarts the cycle, which keeps oxygen in the form of dioxygen. Figure 3 explains the process. In 1974, the time of their theory, CFC's were ubiquitous, used most frequently as aerosol propellants. It seemed possible that life on earth could be ravaged by the hiss of spray deodorant. However, ozone depletion had not shown all its faces yet.

Tan Penguins

In 1985 British scientists surprised the scientific community when they announced they had discovered that a region of massive ozone depletion — an ozone hole — covered the Antarctic continent each year. The hole began late every September, and lasted throughout the Antarctic spring (October to December). Their discovery was quickly confirmed; leftover American satellite data showed that the hole had been occurring for years. Scientists speculated that the causes behind the ozone hole might explain global ozone depletion, and they began to research the phenomenon earnestly. If their findings were unrelated to global ozone depletion, their efforts would be perhaps ill-spent; on the other hand, they might uncover the origins of the global problem and even find a solution.

Some claimed that the hole proved that CFC's were responsible, saying the spring air currents suck stratospheric

Continued on page 9

CFC's to above Antarctica, where they quickly destroy most of the ozone. Others suggested that air currents themselves whisked away ozone-rich air from the pole and deposited it at lower latitudes. Thus, a major competing theory began to gain support, the "dynamic" theory, so named because it is based on the dynamics of climatology — air movements.

The dynamic theory holds that, as the Antarctic winter ends, clouds and natural airborne chemicals heat the Antarctic stratosphere, forming an upwelling of air that forces tropospheric ozone-poor air up into the stratosphere, pushing the high ozone-rich air north towards the equator. As the spring turns into summer, the atmosphere becomes uniformly heated, the upwelling settles out, and the ozone recovers.

The superficial difference between the two theories is that a purely dynamic explanation acquits man of causing the ozone depletion; however, as Jerry Mahlman of Princeton puts it, "[the ozone hole enigma] is not an ideological question of pro-CFC or anti-CFC." Indeed, most scientists attribute the hole to a combination of chemical and dynamic processes.

Muddying the waters further is a theory proposed in 1986 by Linwood B. Callis and Murali Natarjan. They developed an "odd nitrogen" theory that states that during times of increased solar activity, the sun produces nitrogen-oxygen compounds that catalyze the destruction of ozone; the reactions occur on the surface of frozen polar clouds under special conditions present in the Antarctic spring. Their theory predicts that the hole will disappear as solar activity ebbs. Some evidence supports their theory: in the southern hemisphere, nitrogen compounds concentrations surpassed usual levels by 60% during the 1979-1980 solar maximum, a time of peak solar activity.

To make sense out of some of these theories, the United States sent a research

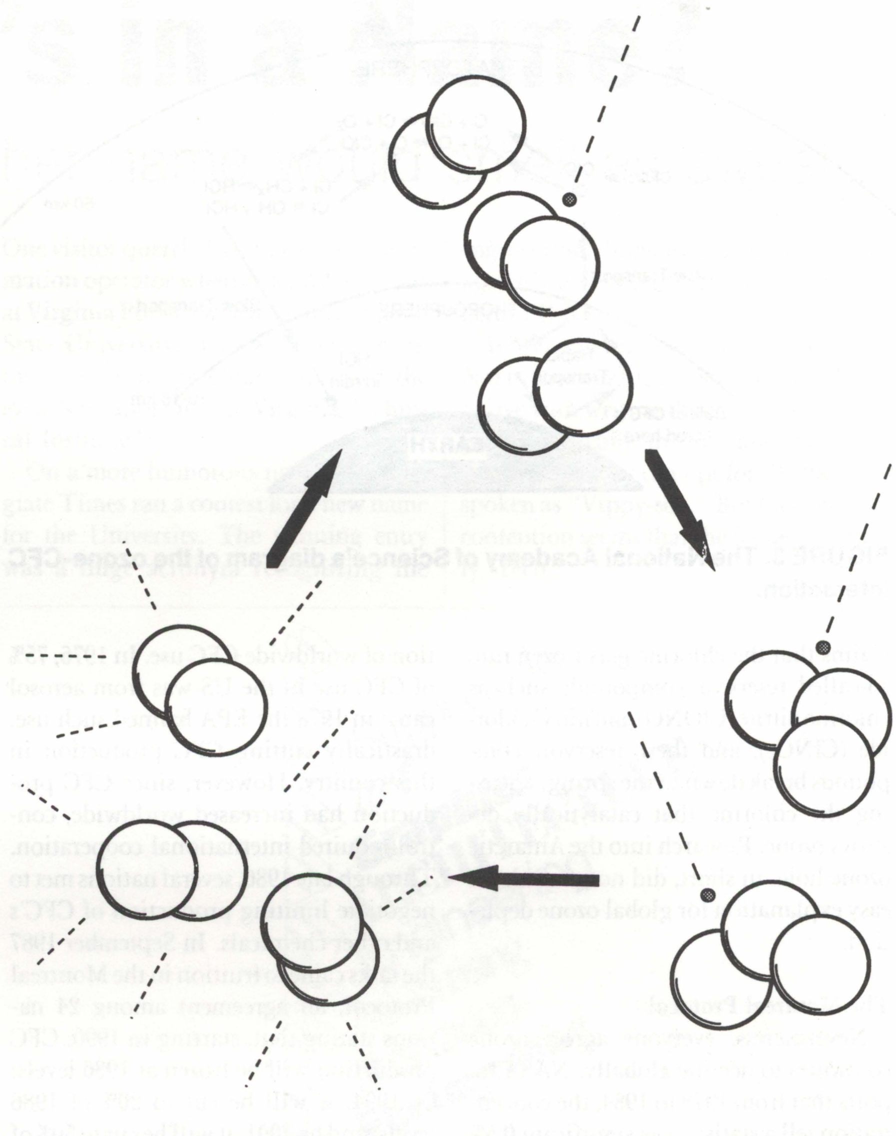

FIGURE 2. Ultraviolet photons create and destroy ozone. In the process, the ultraviolet energy is converted to heat.

expedition called the National Ozone Expedition (NOZE) to Antarctica in August of 1986 to determine what was going on. On October 25 (via satellite from McMurdo Station, Antarctica to a press conference in Washington, DC), NOZE leader Susan Solomon reported that "we suspect that a chemical process is fundamentally responsible for the formation of the hole," discrediting a dynamic explanation.

Furthermore, stratospheric nitrogen levels there were the lowest measured anywhere on earth. However, McMurdo Station is just at the edge of the hole, so scientists doubted NOZE's measurements and virtually ignored their conclusions.

Thus the Antarctic hole remains, puzzling scientists and inspiring still more complicated theories, such as one citing an interaction between nitrogen and chlorine compounds in the stratosphere. It

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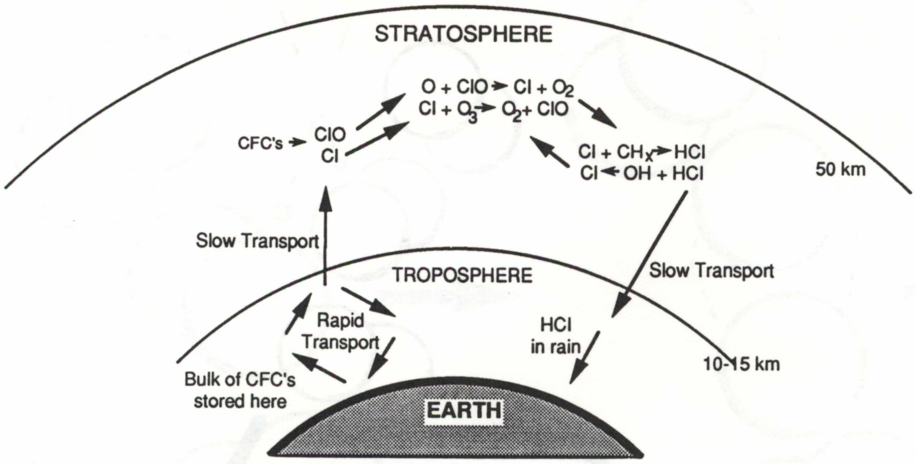

FIGURE 3. The National Academy of Science's diagram of the ozone-CFC interaction.

claims that the chlorine gets frozen into so-called reservoir compounds such as chlorine nitrite (ClONO) and nitryl chloride ($ClNO_2$), and these reservoir compounds break down in the spring, releasing the chlorine that catalytically destroys ozone. Research into the Antarctic ozone hole, in short, did not provide an easy explanation for global ozone depletion.

The Montreal Protocol

Nevertheless, everyone agrees ozone continues to decline globally. NASA reports that from 1978 to 1984, the concentration fell a statistically significant 0.5% annually. Kenneth Bowman of the University of Illinois (working from a NASA grant, incidentally), estimated the annual depletion was approximately 1% instead; NASA claims his measurements came from poorly calibrated instruments — those studying ozone rarely agree. Who should political leaders believe? The Molina-Rowland theory still has not been conclusively confirmed or denied, but today it remains the dominant theory.

In the wake of that yet-unproved but generally accepted explanation, the United States took a leading role in the reduction of worldwide CFC use. In 1976, 75% of CFC use in the US was from aerosol cans; in 1978 the EPA banned such use, drastically cutting CFC production in this country. However, since CFC production had increased worldwide, control required international cooperation. Through late 1986, several nations met to negotiate limiting production of CFC's and other chemicals. In September 1987 the talks came to fruition in the Montreal Protocol, an agreement among 24 nations stating that, starting in 1990, CFC production will be frozen at 1986 levels; by 1994, it will be cut to 20% of 1986 levels; and by 2001, it will be cut to 50% of 1986 levels. These goals are feasible, since alternative chemicals exist for most CFC uses, although the Alliance for a Responsible CFC Policy, formed by the chemical industry, threatened that CFC substitutes will quadruple the cost of products that use CFC's.

What To Do?

The ozone layer is a vital part of life on earth, and it is slowly wearing away. The projections on how much and how soon range from 2% to 18% global depletion by the end of the century; the best estimates suggest 4% to 7% depletion. However, such projections are hazy at best, since atmospheric chemistry involves approximately 125 known chemical reactions; a mistake in accurately describing any of these will render a projection useless. There are still anomalous measurements, as well: no model presently explains why, for example, there seems to be twice as much chlorine monoxide (ClO) in the stratosphere as expected. Similarly, an important controlling chemical, the hydroxyl radical (OH), is present in the atmosphere in concentrations approaching, as one chemist described it, a drop of vermouth in an Olympic swimming pool of gin. Measurements of this kind carry great uncertainty and lead to doubtful analyses.

Although CFC's have only been indicted, not convicted, the Molina-Rowland theory has wide support — even those who hold other theories concede that chlorine is probably a major player. Assuming the CFC theory is correct, and that CFC's were banned worldwide today, one would not notice the effect on the ozone layer for decades, since CFC's permeate the troposphere, where they are extremely stable. Concerning the greenhouse effect, CFC's are a major greenhouse gas, accounting for about one third of the greenhouse gases presently in the atmosphere; for comparison, carbon dioxide accounts for nearly half of the greenhouse gases. Scientists have argued whether greenhouse warming will aggravate or mitigate ozone loss; still, in the latter case, greenhouse warming is an unappealing alternative to ozone depletion. Therefore, the control of CFC's may be important in the future.

In the meantime, research will continue on ozone depletion, CFC's will still escape, the winds will still blow, the sun will still shine, and the ozone layer will still erode.

***Andrew Predoehl** is a junior in Computer Engineering who does not recommend amateurs try riding on the outside of any space vehicle.*

What's in a Name?

'A rose by any other name would smell as sweet...'

Shakespeare could well have been talking about Tech when he wrote those famous words, for the name of this university has caused a stir in the past twenty years. But the name game actually has its roots in the school's founding.

In March of 1872 the Virginia Agricultural and Mechanical College was established with the donation of Preston and Olin Institute property and the signing of a bill by Governor Gilbert C. Walker. Some twenty years later, the trailer "Polytechnic Institute" was added to the name under the administration of Dr. John McBryde. Contrary to popular belief, the nickname "Virginia Tech" did not originate in the past two decades, but nearly 100 years ago during the McBryde administration.

But it didn't stop there. In 1944 the school's legal name became the Virginia Polytechnic Institute. Finally, in 1970 the Virginia legislature added on "and State University" to the name, to indicate the school's expanding non-technical programs.

More recently, the arts and sciences contingent has been pressing for further name changes — "Virginia Tech University," etc. — all in the name of allowing other programs the chance for worldwide recognition comparable to that of the College of Engineering. Dean Torgersen even instigated a study of the current name and its ramifications. The study concluded that the name should not be changed, that the University should simply stick to its guns (its name) and allow the rest of the world to get used to it.

The current name and the nickname "Virginia Tech" have caused some unfortunate confusion. More than one prospective student has been wanted to know if VPI was anywhere near Virginia Tech. One visitor querried an on-campus information operator whether a professor was at Virginia Polytechnic Institute, or at the State University. A local advertisement for an on-campus event designated the event's location as "the Virginia Technical Institute."

On a more humorous note, the Collegiate Times ran a contest for a new name for the University. The winning entry was a huge acronym recognizing the engineering, humanities, business, and agricultural disciplines all prevalent here: EIEIO.

When will the name confusion end? Not in the near future. Students will have to live with writing their address as "Virginia Polytechnic Institute and State University." Or they can opt for "VPI&SU," spoken as "Vippy-soo." But for now, the contention seems that the name is, simply, Tech.

COVER STORY:

THE COLLEGE OF ENGINEERING: **THE DECADE IN REVIEW**

"The school is in transition. If you go back twenty years ago, this was not a major research institution; today it is."

Dr. William Conger,
Department Head, Chemical Engineering

by Tony Giunta

Gleaming in the early May sun, the National Aerospace Plane stood impressively in front of gathered university dignitaries, engineering faculty, and proud students. Soon the mock-up would be flown to the Paris Air Show, to be one of the centerpieces in the American exhibit.

Although the National Aerospace Plane was only one project out of many in the last ten years, it symbolizes the upward direction which the Virginia Tech College of Engineering has taken. Almost every facet of the engineering education in this institution has experienced positive change. Aspects such as the quality of students and faculty, and the amount of research expenditures mirror these advancements and indicate an encouraging future.

In the 1950's and early 1960's the primary role of the College of Engineering was as a teaching institution. However, in 1963 the president of the university, T. Marshall Hahn, began to focus attention on faculty and graduate research. This trend gained momentum and has increased through the last twenty-seven years. Because of this change, Virginia Tech is now recognized in the academic community, both nationally and internationally, as one of the foremost engineering research universities.

Providing the basis for the development of research studies is an increase in funded proposals from 7.5 million dollars in 1979-1980 to just under 25 million dollars in 1988-1989. Coupled with this is growth in both faculty size and graduate student enrollment. While the number of faculty positions has increased modestly from 235 in 1979 to 273 today, the graduate programs have flourished. The number of GTAs doubled from 1979 to 1986, reaching nearly 200 and remaining steady since. Graduate research assistant positions have experienced an even more dramatic climb from 144 in 1979 to over 380 in 1989.

Currently, there are approximately 1200 graduate students enrolled in engineering. This is more than double the size from a decade ago. Furthermore, there are approximately 1000 additional graduate students at satellite campuses around the state. These factors combine to perpetuate the research process; research dollars promote graduate and faculty studies, which in turn attract greater funding.

Although the graduate programs of the college have experienced tremendous growth, the bulk of the engineering enrollment is comprised of undergraduates. In contrast to the boom in graduate programs, the undergraduate numbers have remained somewhat constant. Following the cyclic nature of the engineering industry, some individual undergraduate departments have experienced dramatic size fluctuations. However, the net undergraduate total has varied only slightly. The largest

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THE COLLEGE OF ENGINEERING:
THE DECADE IN REVIEW

"The college as a whole...in the next few years, (is) going to reach a saturation level unless there is a...major addition of space."

Dr. Robert Comparin,
Department Head, Mechanical Engineering

department, electrical engineering, has increased to about its maximum capacity. Conversely, chemical engineering, which once annually awarded over eighty BS degrees, now graduates approximately forty students annually. Interestingly, chemical engineering enrollment is now rising, while electrical engineering enrollment is in a slight decline. The mechanical engineering department reached its capacity in the early half of this decade and actually had to curtail entrance into the department. As student interest and job outlooks change, so does enrollment in each of the engineering disciplines.

Student involvement in the College of Engineering has taken many different forms in the past ten years. The student chapters of professional organizations are an especially important educational aspect, in that they foster student competition in design and other technical areas. Mini-baja cars, concrete canoes, formula race cars, and a solar-powered car have been some of the more recent competitive projects developed through these organizations. In addition to these activities, there are other groups outside of the departments. The Student Engineers' Council (SEC) is one such association which consists of representatives of each of the engineering societies as well as members at large. The SEC organizes both the engineering EXPO held in the fall, and Engineers' Week in the spring.

Although the College of Engineering has flourished academically and professionally, there are some factors that have marred the past decade. Perhaps the most formidable of these obstacles which must be overcome is the lack of space for students and faculty. The top three floors of Whittemore were completed in 1984 and were quickly filled by electrical and industrial engineering. These additions provided some additional space, but did little to solve overcrowding situations in the college as a whole. In a comparison of net square feet per faculty member, the College of Engineering ranked last among forty-four other major public engineering schools. Accreditation reports in this decade have all cited the lack of adequate space as a critical problem.

Currently, there are several projects underway that should alleviate some of the shortfalls. The Engineering/Architecture Infill is expected to be completed by February 1990, and several departments, including chemical, materials, and industrial engineering, will acquire some space in this building. In addition to the Infill, a new 25 million dollar Engineering/Architecture building is currently in the planning stages. However, if approved, the construction would not be completed until midway through the next decade, and would still not eliminate the space shortage. There has been some planning for the needed renovation of existing buildings, such as Randolph Hall, but this has not yet occurred.

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THE COLLEGE OF ENGINEERING:
THE DECADE IN REVIEW

Another unfortunate deficiency in the college is that there is a low number of minority students in engineering. Enrollment figures for both women and black engineers indicate a peak about midway through the decade. The College of Engineering does sponsor some minority programs, but more needs to be done.

The past ten years have been a time of much progress in the College of Engineering. These advancements have provided Tech engineering graduates with experience that other institutions do not offer. The establishment of a personal computer requirement since the 1984-1985 year is one example of the college's commitment to continuously improving engineering education. With a total of approximately 6000 personal computers among the faculty and engineering students, the College of Engineering has taken the initiative among universities in merging computers into the engineering curricula. In the most recent ranking of engineering institutions by *U.S. News and World Report,* Virginia Tech's College of Engineering was rated among the top engineering schools in the country.

The growing process in the college is continuing, although it may now be at a somewhat slower pace than in the past. Further developments, such as the recent establishment of a National Science Foundation Science and Technology Center, will provide the college with the capabilities to expand research and educational possibilities. The strengths in the engineering programs will be the force that propels the College of Engineering into a new decade.

A "C" an "E" and a BABY:

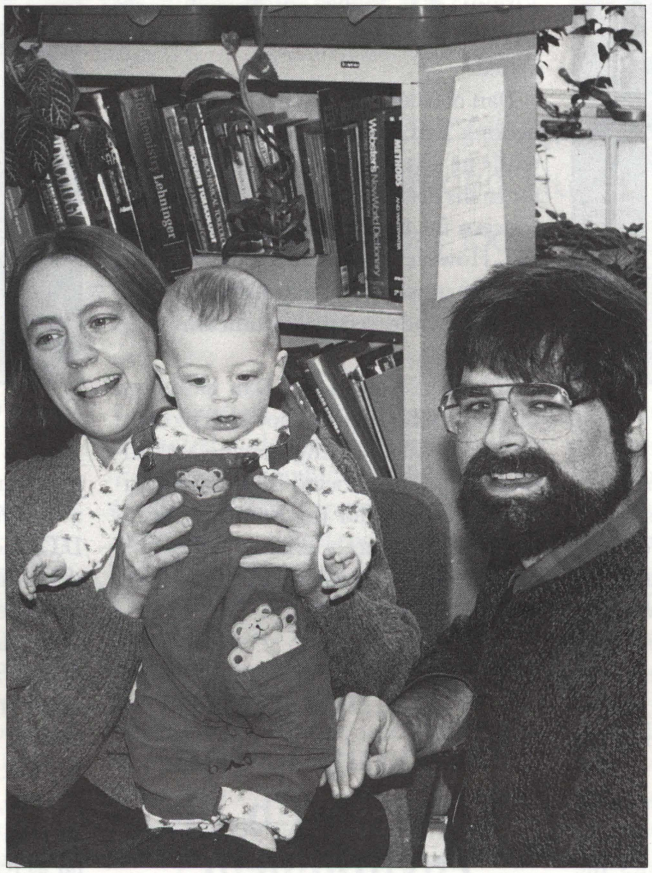
(That's C for Chemist and E for Engineer)

by Jonathan Hess

Once upon a time there were two ambitious graduate students at Drexel University. Little did they know that they were destined to be united — in marriage and in their professions. How were these two brought together? By fate, you ask? Not hardly. More like through long hours of brainstorming sessions while studying for a class in biostatistics.

The two people to whom I am referring are none other than Daniel Gallagher and Andrea Dietrich of Virginia Tech's civil engineering department. With their two offices nestled next to each other on the third floor of Norris Hall, this dynamic duo works very well together.

You might think that there is a lot of competition between the two, since the married couple are in the same discipline. However, this could not be farther from the truth. Yes, it is true that Andrea and Dan are both involved with environmental engineering, under the Civil Engineering department, but they both concentrate on two different yet related facets of work. More specifically, Andrea is an Environmental Chemist, whereas Dan is an Environmental Engineer and working together as a team proves much more lucrative than competing against one another.



Andrea, Owen, and Dan

In fact, since their studying is concerned with the environment, Dan and Andrea have a common point so they can provide each other with either constructive criticism or compliments. Furthermore, working in the same department helps them understand the other person's heavy work load.

Andrea Dietrich received her Bachelors of Science degree from Boston College in Chemistry and Biology, while Daniel Gallagher received his B.S. degree in civil engineering from Drexel University. Both Andrea and Dan continued their education at Drexel, where Andrea was awarded a Masters degree in environmental chemistry, and Dan obtained his Masters degree in environmental engineering. Finally, they both completed their formal education at the University of North Carolina at Chapel Hill, with Andrea acquiring a Doctorate in environmental chemistry and Dan earning his Doctorate in environmental engineering.

Here at Virginia Tech, Andrea teaches CE 5104, an Environmental Chemistry class that covers environmental aspects of organic and inorganic chemistry including areas such as oxidation-reduction, Acid-Base, solubility and fate of pollutants. Aside from this, she is also involved with research encompassing water treatment, the use of chlorine-dioxide for disinfection as an alternative for chlorine gas, reverse osmosis, and the land application of municipal sludges.

The Environmental Protection Agency (EPA) has many laws that must be met in order to insure safety against toxic compounds. The majority of Andrea's research concerns meeting the standards set by the EPA for the compounds used in our environment. For instance, her work with chlorine-dioxide as an alternative disinfectant to chlorine gas is extremely important because according to the EPA, chlorine gas produces many potentially toxic compounds.On the same note, reverse osmosis is the ability to remove pesticides from ground water in order to meet the Safe Drinking Water Act. Finally, her work with the land application of municipal sludges deals with the analyzation for organic substances that are potentially toxic.

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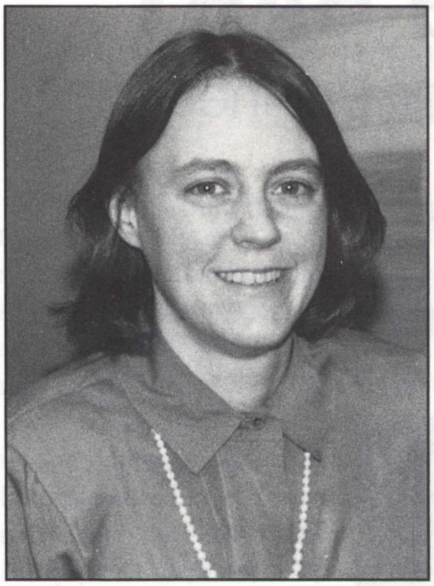


Andrea Dietrich

Andrea is very content with the position she is in because she enjoys problem solving, and environmental problems must be solved to preserve the earth for the future. In addition, she is drawn in by the fields complexity. With these motivations behind her, Andrea ultimately considers herself a "detective" of sorts, in that she never wants to stop discovering the fates and effects of chemicals.

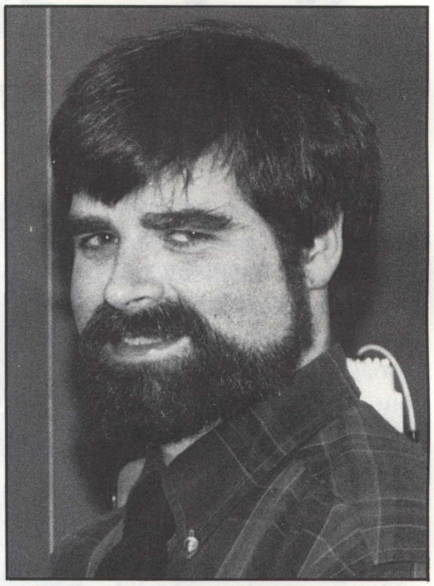
On the other hand, Andrea's husband Dan is not very involved with the "detective" work, rather he manipulates the data to make sense of it. Aside from the two classes he teaches, CE 4124 Water Quality Management, and EF 1024 Pascal For Engineers, Dan is involved with various research projects. This research is comprised of the modeling and tracking of water flows and specifically the contaminants within the water distribution system. All modeling is done on computer, because Dan feels the computer can achieve optimal monitoring strategies; one of his premiere goals is to make the computer and its software more useful to the end user. One reason this modeling is so important is that monitoring is required by the state, and this provides an effective check.

Another area which Dan was involved with was a project which modeled ground water contaminants for the Virginia area. In this project, the state of Virginia was divided into five different sections and each was individually analyzed.

Dan decided that environmental engineering was for him in the mid 1970's while he was an undergraduate. One factor in his decision was the overwhelming concern for the environment in the mid 70's. However, the one thing that interests Dan the most about environmental engineering is the diversity of studies involved in the field.

Together, Andrea and Dan have been very successful. In fact, they both received the Environmental Engineering and Science Fellowships award from the American Association for the Advancement of Science. There are a total of ten people per year picked to receive this award and they were both chosen the same year. The award allowed them to go to Washington D.C. and see the political implications of scientific work within Congress and various executive departments.

"...since their studying is concerned with the environment, Dan and Andrea have a common point so they can provide each other with either constructive criticism or compliments."



Daniel Gallagher

As far as scientific achievements go, Andrea and Dan's greatest came this past summer when Andrea gave birth to a healthy baby boy named Owen. Owen has altered their lifestyles considerably. For one, Andrea said "the days get tighter and the nights are donated to Owen." As far as research is concerned Andrea finds that she must get more done during the day, while Dan finds himself doing more at home because it is more convenient.

Although free time is scarce, when some is available both Andrea and Dan enjoy hiking. Individually, Andrea likes gardening, while Dan prefers computer programming. Even though both of their lives have changed significantly since the arrival of their son, they still try to find time to do things that make them happy outside the office. However, at the moment, the happiest thing in Andrea Dietrich and Dan Gallagher's life is their new son Owen.

The Truth About Accreditation

The recent visit by the Accreditation Board for Engineering and Technology (ABET) has caused some questions among students. What does accreditation involve? What were the visitors looking for? Will any program not be accredited? These questions deserve some answers.

by Andy Stalder

ACCREDITATION

ABET accredits individual undergraduate and graduate programs (i.e. aerospace, electrical, etc.) at schools like Tech based on curricula, faculty, student body, and facilities. Ph.D. programs are not accredited. Accreditation for programs is valid for three or six years, depending upon the degree of ABET approval. Among universities nationwide, Tech is one of the few schools to regularly receive 6-year accreditation nearly across the board. (MIT, Purdue, and a couple others have this distinction).

The guidelines for evaluation are provided to schools and to judging ABET consultants in a yearly-updated publication, Criteria for Accrediting Programs in Engineering in the United States. The publication establishes general criteria for the College of Engineering, such as quality of faculty and curricula general content. Guidelines are then provided for each department; these are merely slight revisions to the general curricula guidelines which are specific to the discipline. The department guidelines are typically established by the relevant society: ASME, AIAA, etc.

In a nutshell, the requirements call for a balanced academic program, consisting of one year of combined math and basic sciences, one year of engineering sciences, and a half year each of engineering design and humanities and social sciences. These are the minimum requirements. Engineering sciences, incidentally, are really any non-design engineering topics. The non-specific nature of the requirements allows for frequent negotiation over what constitutes design, science, etc.

The accreditation process is routine. Following the school's submission of much paperwork, a team of consultants from ABET visits the campus. These consultants are industry engineers or society representatives, paid for their work with fees from the school. The consultants will typically inspect facilities, talk to professors and students, sit in on classes, and the like. Suggestions for improvement are occasionally made during the visit.

Following the visit, the ABET team may ask for a sample of transcripts or work of an arbitrary number of students. This is done to check on programs' requirements.

Several years ago, there was a concern that engineers were graduating without knowing how to design. This was reflected in the change in evaluation criteria to require a half year of design-based engineering. More recently, there have been attempts to water-down the strict design requirements, particularly from non-design oriented fields like EE and CHE. These efforts have so far failed, however.

ABET'S VISIT TO TECH

ABET's visit to Tech in October was largely without incident. Tech has two new academic programs which are up for evaluation, Computer Engineering and Ocean Engineering. These programs are expected to be approved for accreditation.

Rumors had been circulating among students about two topics in particular. First, there was concern regarding the Chemical Engineering Unit Operations Lab. Also, Electrical Engineering was short on space, according to some students. Both of these rumors proved to be false alarms. The Unit Operations Lab is being moved to the new Infill building; ABET merely wanted to assure that the transition did not leave any students in limbo. The issue of space, meanwhile, is not a negative concern to ABET. In contrast, any comments to the effect that Tech

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engineers need more space can be used to fuel arguments for additional College of Engineering buildings.

In an exit interview with President McComas, Dean Torgersen and Dean Marchman, the ABET team spoke of Tech with praise. Especially commended were the quality of faculty and student body. The team also spoke negatively of the semester conversion, saying it was hard on students — and on the team, since they had to analyze the part semester/part quarter programs!

Tech will receive a preliminary report in February from ABET, but the final approval will not take place until July. Pending that approval, Ocean and Computer Engineering grads will receive retroactive accreditation on their programs.

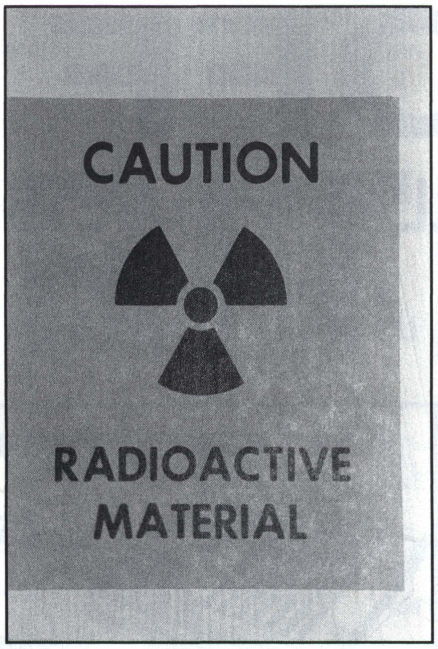
IMPORTANCE OF ACCREDITATION

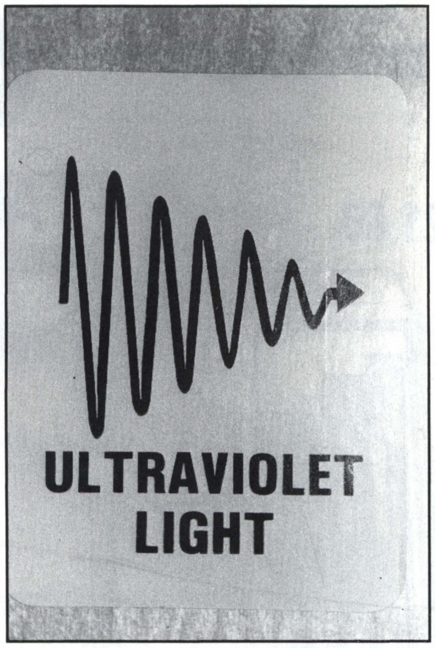
The importance of accreditation for a program is actually questionable. No one is going to kick you out of your $35k job with IBM if they find your degree was not in an accredited program. Some very good engineering schools don't bother getting their programs accredited; they let their programs rest on their reputation. However, some graduate school programs (including some at Tech) require an accredited degree. The funny thing is, in that case a master's program requires an accredited program degree; a Ph.D. program doesn't. You figure it out.

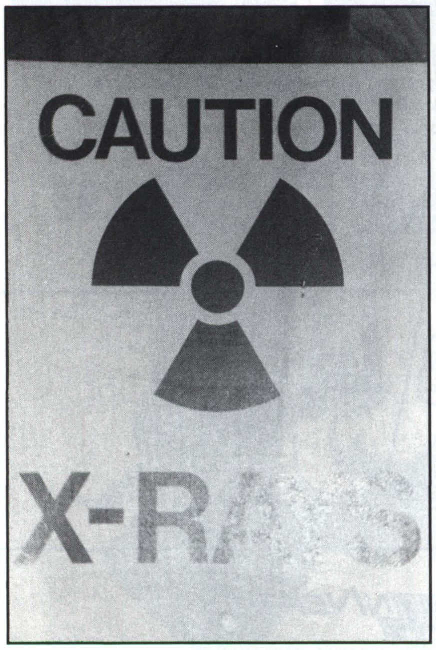
PHOTO ESSAY: Signs of the Times

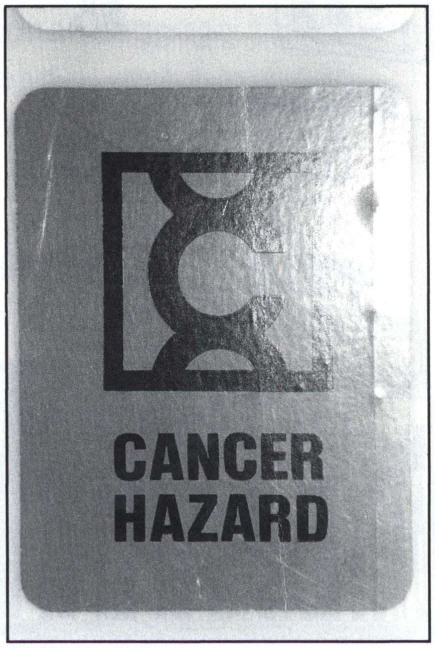
Engineers' Forum takes a look at some of the more interesting — and foreboding — signs scattered around the Virginia Tech campus.

Photos by Howard Kash









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