Engineers' Forum

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Engineering in the Military

Engineers' Forum

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Letters

The College of Engineering at Virginia Tech is often ranked highly for the education it provides its students. I find it truly amazing however that a school of this caliber should be so far behind in terms of computational facilities. The computer system we use forces many students to use punched cards whereas in industry, such use is unheard of. The computers we use are inefficient for many of the scientific calculations we perform. For interactive use, response time is often very slow due to the high ratio of interactive users to computers.

Furthermore, some of the professors doing research involving large finite element models of fluids or structures, finite difference models for aero-thermo reentry heating, computational aero-dynamics, etc. find our system incapable of handling their problems. As a result, these problems and others must be run on systems of industry or government.

If the College of Engineering would purchase one or several computers for scientific calculations, many of the disadvantages of our system could be eliminated. This approach has been followed by other large engineering schools. Some of these schools have mini-mainframe computers such as VAX or PRIME for each department. This allows more flexibility for both students and professors to solve problems.

An engineer is supposed to be a "problem solver" and if we are limited in our training to solve problems by the lack of adequate computational facilities, we are failing to uphold the trust being placed on us by society: We are not being sufficiently prepared to approach the problems the future has in store for us.

Peter Stein
Senior, ESM

I certainly was impressed by the response to my article by M. Summers which you published in your winter issue (otiose yet, I'm glad to see that we've been using our thesaurus).

What better way to respond to a tongue-in-cheek article than with a tongue-in-cheek letter. With all due humility, I must admit that on the tongue-in-cheek (or is it the foot-in-mouth) scale, Miss Summers has topped me. Even as a former resident of New Jersey, I would never in my wildest dreams write about an "awesome NFC football team." (Presumably we are talking about the NY Giants, who play their games in NJ (though they have chosen to obscure this fact by retaining "New York" as their name) a team so "awesome" that they did not even make the playoffs this year. New Jersians can console themselves that other powerhouse teams, such as the Colts and the Rams didn't make the playoffs either).

I applaud Miss Summers' apparently unlimited audacity in writing about beaches and casinos while ignoring offshore sewage dumping and organized crime. But maybe unlimited audacity is characteristic of New Jersey which in spite of its numerous toxic chemical dumps calls itself the "Garden State."

L. Shaw

I understand that Warp number is a measure of speed, where the speed is given by the third power of the Warp number times the speed of light. Why is this so?

Robert Villamil
Graduate Student, EE

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Are You a Real Engineer?

By Lee Shaw

"Am I an engineer?" This is a question that some of you have probably asked yourselves many times during your collegiate career. I know I did, generally right after I'd learned that the professor and I had widely diverging ideas about what should be on a test. It doesn't matter whether you have known that you wanted to be an engineer since you were two years old (Don't laugh — there really are people like that) or whether you decided to be an engineer only after reading about plant trips in my earlier article in this classy publication.(Author's note: The editor made me say this.) (Editor's note: that's not true. Lee wrote that of his own free will.)

At some point you will wonder whether you really might be happier if you changed your major to Medieval Germanic Languages (or Accounting or Finance or something equally obscure). Most engineering students resolve this dilemma rather quickly, when they investigate the employment opportunities for specialists in Medieval Germanic Languages, but some are still haunted by the question, "Am I really an engineer?" If you fall into this latter group, read on: maybe this article will help you discover the answer. Then again, maybe not —but what do you expect from an unpaid writer for a free magazine?

PART I: A COUPLE OF PAINLESS WAYS TO PROVE THAT YOU ARE AN ENGINEER

If financial considerations (such as finding a job) alone aren't enough to convince you that you are engineering material, but you desperately want to be reassured that you are an engineer, there are a couple of arguments you can try, although neither will hold up under rigorous self examination.

Argument 1: "I am an engineer because I say I am an engineer." This is kind of like the power of positive thinking, but not really. It will work if you are stupid. (Believe it or not, being stupid does not automatically disqualify you from being an engineer, any more than it disqualifies you from being a football coach or a politician). This argument breaks down when you look at some of the people who call themselves engineers, like garbage collectors. Now don't get me wrong, I'm not saying that garbage collectors (who call themselves "sanitation engineers") don't perform an important function, but how much engineering does it take to dump a trashcan into the back of a truck?

Argument 2: "I am an engineer because I am studying engineering/because I do engineering work." This is a better argument than argument 1, and in fact is quite popular, but like argument 1, it doesn't hold up when the facts are examined. For example, there is the individual known as "Mr. T" who appears in a television series. He performs the role of an actor, but can anyone watch that show and seriously say that he is an actor? Or take federal employees, or "public servants;" they serve the public by operating the government, but when was the last time you went into a government agency and felt like you were being "served?" (especially around 5:00 or around lunch time.)

If neither of these arguments convinces you that you are an engineer, you are in serious trouble. In fact, you might want to reconsider the above arguments before you get down to:

PART II: THE NITTY GRITTY

This short multiple-guess quiz should separate the real engineers from the quiche designers. Answer each of the questions to the best of your ability. Your score will tend to reflect your engineering potential. (Note that these directives are an examples of good engineering writing: They seem to say one thing while actually leaving a loophole as big as the Imperial Death Star.)

1. Which causes the most damage to the interstate highway system: (A) a 40-ton eighteen-wheeler; (B) trucks do not damage highways; (C) a small Japanese pickup truck.
2. In the last issue of *EF*, a caption for an illustration read: "Daryl (sic) Tewell lives 10 miles from work. He gets there in 5 minutes." What is the first thing that popped into your mind when you read this? (A) "I wonder if he gets good gas milage;" (B) "My pickup truck can run that sucker off the road any day;" (C) "That's 120 miles-per-hour."
3. Does the light in the refrigerator go out when you close the door? (A) Who cares? (B) Of course; (C) It is impossible to determine —when an observer is introduced into a system, the system is disrupted, thus we are not sure that what an observer observed was what would have happened had the observer not been present.
4. As your first job assignment, you are assigned to design an extremely efficient automobile —one which must stop at a gas station every 1000 miles to drain the excess fuel which it has produced. From your training you know that this is an impossible goal. What do you do: (A) Go ahead and work on the project and soak your employer for money, even though you know that you aren't accomplishing anything; (B) Tell your boss that you don't think it can be done, but suggest that a committee be appointed to study the problem further; (C) Tell your boss that it can't be done and that he's crazy if he thinks you're going to waste your time trying.
5. What is the sound level (in dB) of the sound of one hand clapping? (A) This is an interesting question, involving aspects of zen; (B) This cannot be determined; (C) While our mathematical model for hand clapping sound level does not cover this case, using repetitive computer simulation techniques, we have arrived at a figure of 43 dB, accurate to +4.71%.

ANSWERS:

1. The answer is obviously "A." If you answered "B," you have been listening to too much Independent Truckers Association propaganda. If you answered "C," you have been listening to too much UAW and Chrysler Corp. propaganda.
2. Engineers are notoriously number oriented. The average engineer computes Tewell's velocity almost instinctively, so answer "C" is correct. If you answered "B," you are a redneck. Go home, set yourself

down and stick your compass between your cheek and gums.

3. As everyone knows, the answer is "B." (If you're interested, this result can be verified by drawing an electrical diagram of the refrigerator and by majoring in EE, although most engineers arrive at this result instinctively.) Choice "A" is an understandable reaction, but not what I was looking for. If you selected "C," you are more suited to be a quantum physicist than an engineer. See my upcoming book *Are You A Quantum Physicist?* which should be in your local bookstore shortly after the federal budget is balanced.
4. The correct answer is "B." This illustrates the importance of being honest while also cleverly passing the buck to someone else. As an engineer, you will be expected to critically assess ideas and give your opinion. Try to exercise a little judgement though. If you selected "C," you have all the tact and subtlety of an intercontinental ballistic missile. If you chose answer "A," you attitude is more suitable to working for the postal system or being a tax lawyer than an engineer.
5 While there are times to admit that something can't be done (or specifically that you can't do them), this is not one of them. This is precisely the type of question that engineers are paid to answer: It is specific and it is quantitative. Your employer doesn't care about Zen (yes, that means that those of you who selected "A" are wrong). He also doesn't want to hear that you can't do it — he wants an answer, so the correct answer is "C." While this answer has more holes in it than the average muffler in the commuter lot, it sounds good. It has all the buzzwords like "computer simulation" and "accurate to" and more importantly, it gives you a way out if you're wrong — you can blame it on "erroneous assumptions in our computer model." Remember, computers are making the world safe for incompetence. (If you don't believe this, just try to get someone at the phone company, the electric company, or even Va. Tech to admit that he or she might have made a mistake. You will soon find out that people no longer make mistakes — only computers do.)

SCORING

If you answer any of these stupid questions, you are obviously not a "real engineer." A real engineer doesn't need reassurance from some smart alec writer in a bush league magazine (sorry guys). However, don't think that just because you took the quiz, you can't be an engineer. Unlike child prodigies, engineers are made not bored (I mean born). The real purpose of this quiz is to evaluate your engineering potential, so if you do well on this quiz, with some work on your part you can become an engineer. Here's how to grade yourself:

1) Add up the numbers of the questions you got right. (You get one point for question 1, two points for question 2, etc.)
2. Subtract the numbers of the questions you got wrong. Subtract an additional point if you answered "C" for number 3.
3. If you did not use a calculator, subtract half a point (If you want to be an engineer you must learn to use engineering tools.)
4) Take the square root of your total number of points (computed in steps 1 through 3). This represents your engineering potential.

EVALUATION

If you scored 4.0 or higher, your potential is not as high as you think. Go back and figure your score again. The maximum possible score is 3.873.

If your score was a real number you have the potential to be a real engineer.

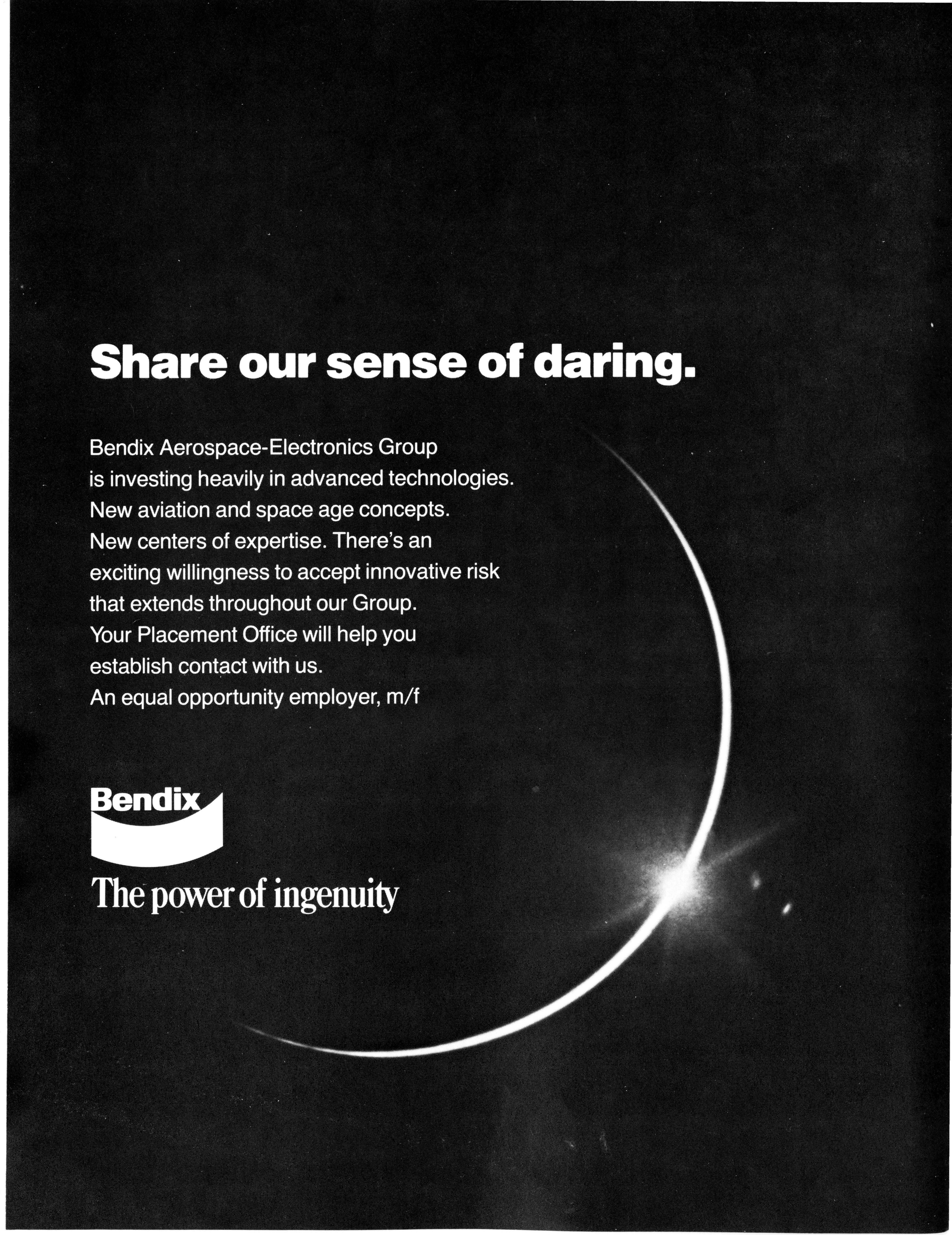
If your score was imaginary (This means that you tried to take the square root of a negative number, Ace), you only have the potential to become an imaginary engineer. Don't fret. Many people are very happy pursuing careers as imaginary engineers.

If your score was zero, you can draw your own conclusions as to what that means.

I hope this article has been of some help to you, but if it hasn't, I'm not going to lose any sleep over it.

Niall Duffy

Lee Shaw is a recent Electrical Engineering graduate from a large state university in south western Virginia. He is currently employed in the microelectronics industry in the Baltimore-Washington area.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The Computers are Coming! The Computers are Coming!

by Erann Gat

Computers in engineering are no longer the wave of the future; they are the wave of the present,and Virginia Tech has been lagging behind other colleges in the country in getting its students prepared for working in a computer-oriented world. Much computer work at Virginia Tech is still being done with punched cards, and most engineering students don't get on a computer terminal until their junior or senior year.

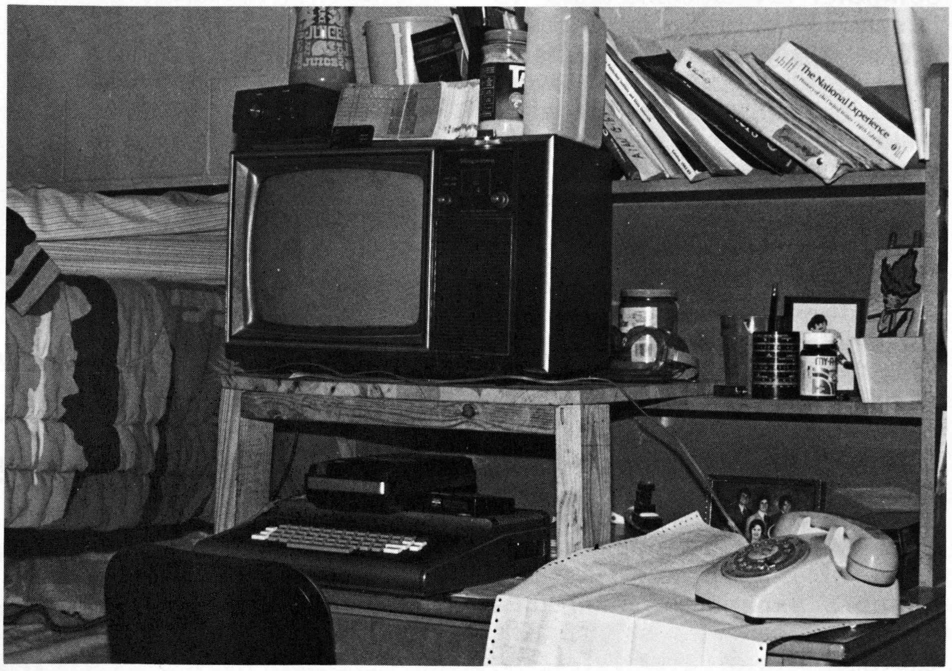
But this is soon gong to change. The College of Engineering is committed to building a computer curriculum equal to any in the country said Dr. Carl Herakovitch, chairman of the Dean's Ad Hoc Committee on Undergraduate Computer Capabilities. This goal will not be an easy one to achieve. Many colleges have already integrated computers as a basic part of their engineering curricula. At Carnegie/Mellon University every student is required to buy a microcomputer. At Rensselaer Polytechnic Institute every student, regardless of curriculum, has a timesharing account on the school's main computer (an IBM 3033). By contrast, even batch-processing accounts are hard to come by at Virginia Tech, and almost unheard of for freshman or sophomores.

To try to catch up with these colleges, the Dean's Committee has set up the following goals in a draft proposal. Computers will be fully integrated into engineering curriculum and research activities, with as much work as possible being done on microcomputers. Each member of the engineering faculty will have access to a personal computer or be required to buy one. Essentially unlimited computer time on mainframe facilities will also be provided. The committee's primary goal is to insure that all Virginia Tech engineering faculty and students are computer literate.

The key to giving students and faculty more access to computer equipment is obtaining more computer equipment. The primary obstacle is, of course, money. Cost estimates of upgrading the computer facilities at Tech range from half a million to 1.5 million dollars. Some of the money will come from the state. Some will come in the form of corporate grants. IBM and several other computer companies regularly donate either money or computer equipment to colleges. Virginia Tech currently has such grants. Can Tech afford it? "We have to," said Herakovitch.

The buildup of computer equipment will take place gradually over the next few years according to a draft proposal from the Dean's Committee. By next fall, the college hopes to equip an 80 unit microcomputer laboratory, with 20 more microcomputers available for faculty use. One such facility already exists on campus. It is located in building 270 which is the small white building behind Randolph Hall. The current facilty houses 35 IBM Personal Computers and is available for general student use. Anybody with a validated Tech I.D can check out software and use the computers whether the work is for a class or not.

By fall of 1984, the Committee hopes to acquire an additional 100 microcomputers. These will be



Nathnael Gebreyes

This should be a familar sight in the near future—microcomputers in dorm rooms.

connected to Virginia Tech's main computer in Burruss Hall to act as smart terminals. They will be used mainly for the freshman introductory computer course, which could be extended to a full year sequence. The expanded course would cover interactive computing, computer graphics, and text processing in addition to the FORTRAN which is currently being taught.

By fall 1985, the draft proposal recommends that every freshman engineering student be required to buy a microcomputer. To ease the financial burden, a plan could be implemented whereby engineering students buy their computers from Virginia Tech in installment payments. At the end of four years, the computer would belong to the student. Another possibility is that some enterprising entrepeneurs will open computer stores in Blacksburg which would offer a wide range of computers at competitive prices.

In addition to personal computers, the mainframe computer facilities will probably also be expanded, and the entire campus will be connected to a data transmission network to allow communication between the various personal computers and the mainframe computers. Part of this network is already in place and currently connects the central computer in Burruss Hall to terminals in McBryde Hall, building 270, and several other areas on campus. Ultimately, the network could extend to every academic building on campus and possibly even dormitories.

Whether these recommendations are actually implemented and whether the College of Engineering can meet its goal of essentially unlimited computer time for engineering students remains to be seen. One thing that is certain is that some sort of change in the curriculum will occur in the not too distant future. IBM has already announced that it will no longer service its card-punch machines, so these will have to be phased out. Most of the "powers-that-be" support expansion of Tech's computer faciliteis said acting University Provost John Perry. The disagreement is only over how much is needed, and when it should be bought.

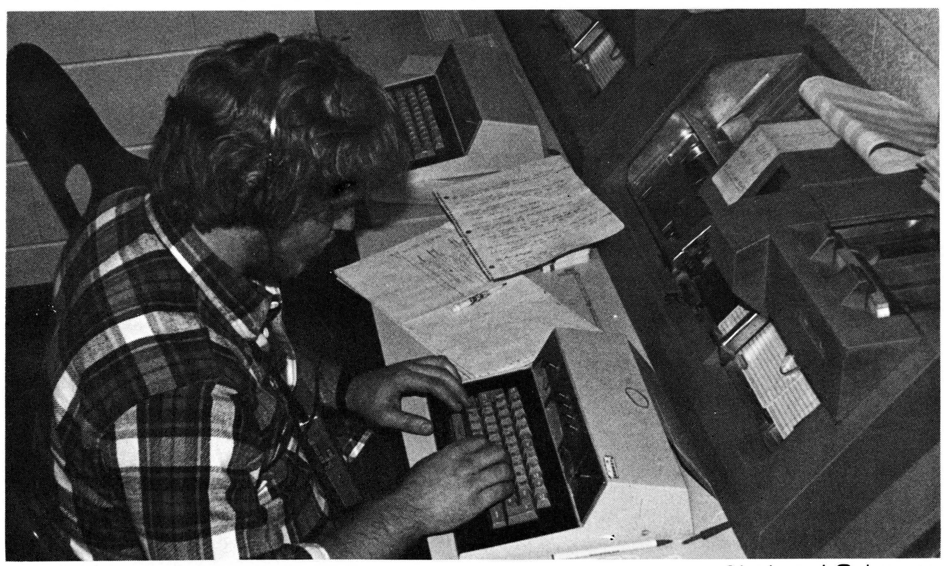
ME's Lead the Way with CAED

The Mechanical Engineering Department's Computer Assisted Engineering Design (CAED) program may serve as a model for the entire College of Engineering for integrating computer into the standard engineering curriculum. The CAED facility consists of a Digital Equipment Corporation VAX 11/780 computer and several graphics terminals, plotters, printers, and other peripheral devices. The facility is only available for Mechanical Engineering students enrolled in one of the nine CAED courses.

J.B. Jones, head of the Mechanical Engineering department is very proud of the facility which was acquired largely with departmental money saying, "We knocked ourselves out to get that computer." Jones hopes that the rest of the Engineering departments will soon offer CAED programs similar to the one in mechanical engineering. Computers could be integrated into every part of the engineering curriculum, said Jones to solve problems that are impractical or impossible to solve by hand. In a statics class computers could be used to find the reactions of a rigid body under a range of applied loads, instead of a single load. In a networks design class a computer could be used to analyze a network using thousands of different component combinations, and pick the one that works the best. The possibilities are endless.

Why has it taken so long for the College of engineering to follow the precedent set by the Department of Mechanical Engineering?

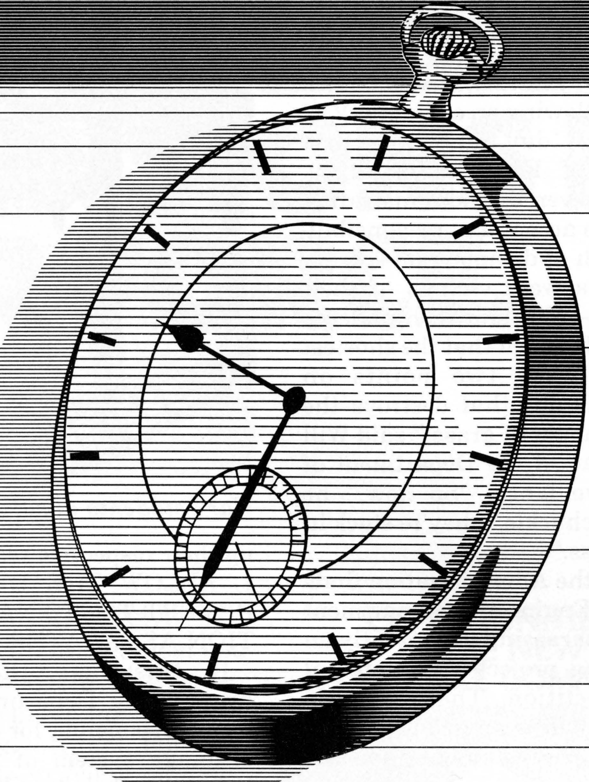
Herakovitch attributes the delay to "inertia" among the faculty. But regardless of the cause, the computers are finally coming, and they will be here to stay.



Nathnael Gebreyes

The infamous card punching machine. IBM is discontinuing service to its machines.

Take the time to talk about your career



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ENGINEERS PUZZLED BY WOODCHIP PATH

by Erann Gat and Veronica Denney

Wary students avoid threatening woodchip path. Nathnael Gebreyes

Students are disappearing from the Virginia Tech campus. Yes, that insidious claimer of coeds and jocks alike known as The Woodchip Path has been swallowing an estimated 2.36 students each day since the first rainshowers of Fall Quarter, 1982. Thus far, however, the Administration has refused to accept any responsibility for the rash of disappearances.

"Those kids were victims of their own laziness — Virginia Tech students have always believed that the shortest distance between two points on campus is the one that destroys the maximum amount of grass," said Will Stickinit, Head of the Department of Student Surveillance. "So now," he added with a chuckle, "they're stuck in their own mess."

Well, what the Administration finds amusing, the Engineering Department admits is embarassing. Apparently an award-winning project in a National design competition, The Woodchip Path is nonetheless an acknowledged failure of engineering imagination and initiative.

"We're very sorry about the mud," said Dr. T, Department Head.

Dr. T has also offered the University and its students and Administration alike a way to extricate themselves from this somewhat sticky situation.

"I believe that this is a critical problem, but that the Department on campus best-equipped to solve it is ours — Engineering. I mean, Biology (Dept.) has only offered to explore the mire for new or unusual life forms, and Business (Dept.) believes it can sell plots (of the drillfield) to condominium developers. I think we can do better than that," Dr. T said with determination.

"We have come up with the following equation to express the rate at which the path widens, subject to several realistic constraints;

$$Rw = ONP^2Kdl$$

Where N is equal to the number of people who use the path each day, P is equal to the amount of precipitation which falls on the path, l is equal to the length of the path, and K is a constant expressing the measure of how desirable it is to have grass growing at a particular point along the path."

Given the above equation with which to study the problem, several of the Engineering departments have evaluated the Path problem and drawn up their respective recommendations.

1. ALLOW THE DRILLFIELD TO REVERT TO ITS NATURAL FUNCTION AS A WATER RESERVOIR.

In this case, the Agricultural Engineering Department has offered to be responsible for plugging up the drainage system of the drillfield in order to allow it to fill with water, which is its natural tendency. Upon completion of that task, the educational possibilities are extraordinary. Civil Engineering students could practice building suspension bridges across the new lake, or Building Construction students could experiment making seaworthy vessels with which to carry on-campus students back and forth on their way to class. This solution certainly offers exciting potential.

2.MOVE McBRYDE HALL.

Civil Engineering professors have offered to explore developments in large scale transportation operations which would make a feasible project of airlifting McBryde Hall to the location of Burruss, the administrative building. Consequently, Burruss would be put down in what is now the location of McBryde. The advantage of this move lies in the fact that McBryde would then be accessible to on-campus students by way of the existing cement path already laid across the drillfield.

3.PUT A DOME OVER THE TECH CAMPUS.

Mechanical Engineers have expressed a desire to research the possibility of constructing a dome to cover the entire campus. This dome would successfully reduce the amount of precipitation which could reach the drillfield, and it would reduce it to a sufficient degree to eventually stop the expansion of the path (see previous equation). Not only would the dome solve the problem of the Woodchip Path, it would also put Tech on the map for having the largest such construction in history.

4.INSTALL AN ELECTRIFIED FENCE AROUND THE DRILLFIELD.

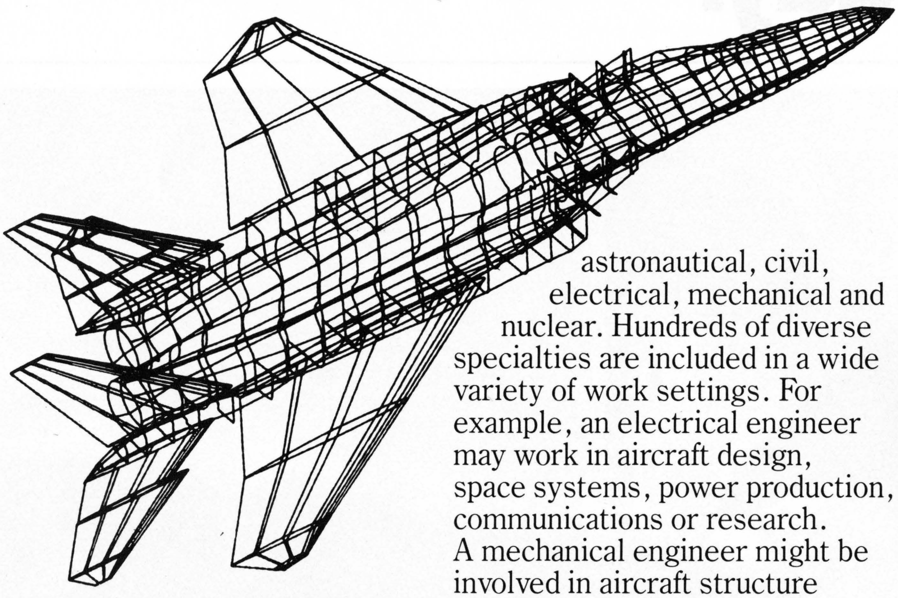
This suggestion focuses on reducing the "N" term of the equation above. The Electrical Engineering Department has offered to design an electrically wired fence to enclose the drillfield which would certainly jolt pedestrians into second thoughts about crossing on the grass.

5. REPLACE ALL GRASS ON THE DRILLFIELD WITH ASTROTURF.

As a last resort, the Mining and Minerals Engineering Department suggested that upon failure of all other attempts to overcome the problem of the Woodchip Path, they would have students assigned to tear up the existing grass (to be sold as sod) and "plant" astroturf in its place. The initial expediture, they claim, would pay for itself eventually in the reduced expense of re-seeding the drillfield every summer Quarter.

None of these suggestions is a sure bet to solve the Woodchip Path problem, but at least they offer hope. Hope that more lives, and more Duck shoes not be lost before the Virginia Tech Administration accepts its responsibility toward its students. The Engineering Department has done its best to resolve the problem; it is now up to the Administration to either pick one of their suggestions, come up with a better one or Stickinit themselves.

ENGINEERING TAKES ON EXCITING NEW DIMENSIONS IN THE AIR FORCE.



Computer-generated design for investigating structural strengths and weaknesses.

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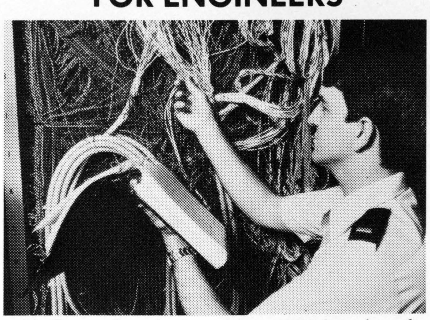
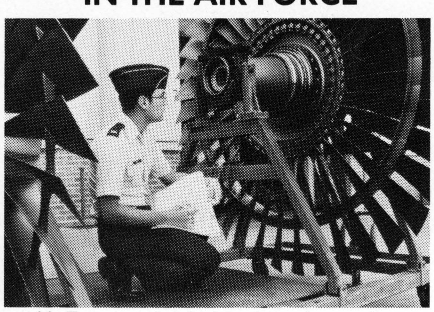
8 CAREER FIELDS FOR ENGINEERS



Air Force electrical engineer studying aircraft electrical power supply system.

Engineering opportunities in the Air Force include these eight career areas: aeronautical, aerospace, architectural, astronautical, civil, electrical, mechanical and nuclear. Hundreds of diverse specialties are included in a wide variety of work settings. For example, an electrical engineer may work in aircraft design, space systems, power production, communications or research. A mechanical engineer might be involved in aircraft structure design, space vehicle launch pad construction, or research.

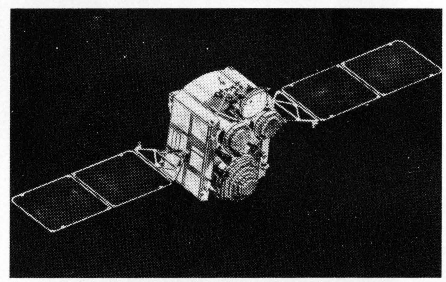
PROJECT RESPONSIBILITY COMES EARLY IN THE AIR FORCE



Air Force mechanical engineer inspecting aircraft jet engine turbine.

Most Air Force engineers have complete project responsibility early in their careers. For example, a first lieutenant directed work on a new airborne electronic system to pinpoint radiating targets. Another engineer tested the jet engines for advanced tanker and cargo aircraft.

OPPORTUNITIES IN THE NEW USAF SPACE COMMAND



Artist's concept of the DSCS III Defense Satellite Communications System satellite. (USAF photo.)

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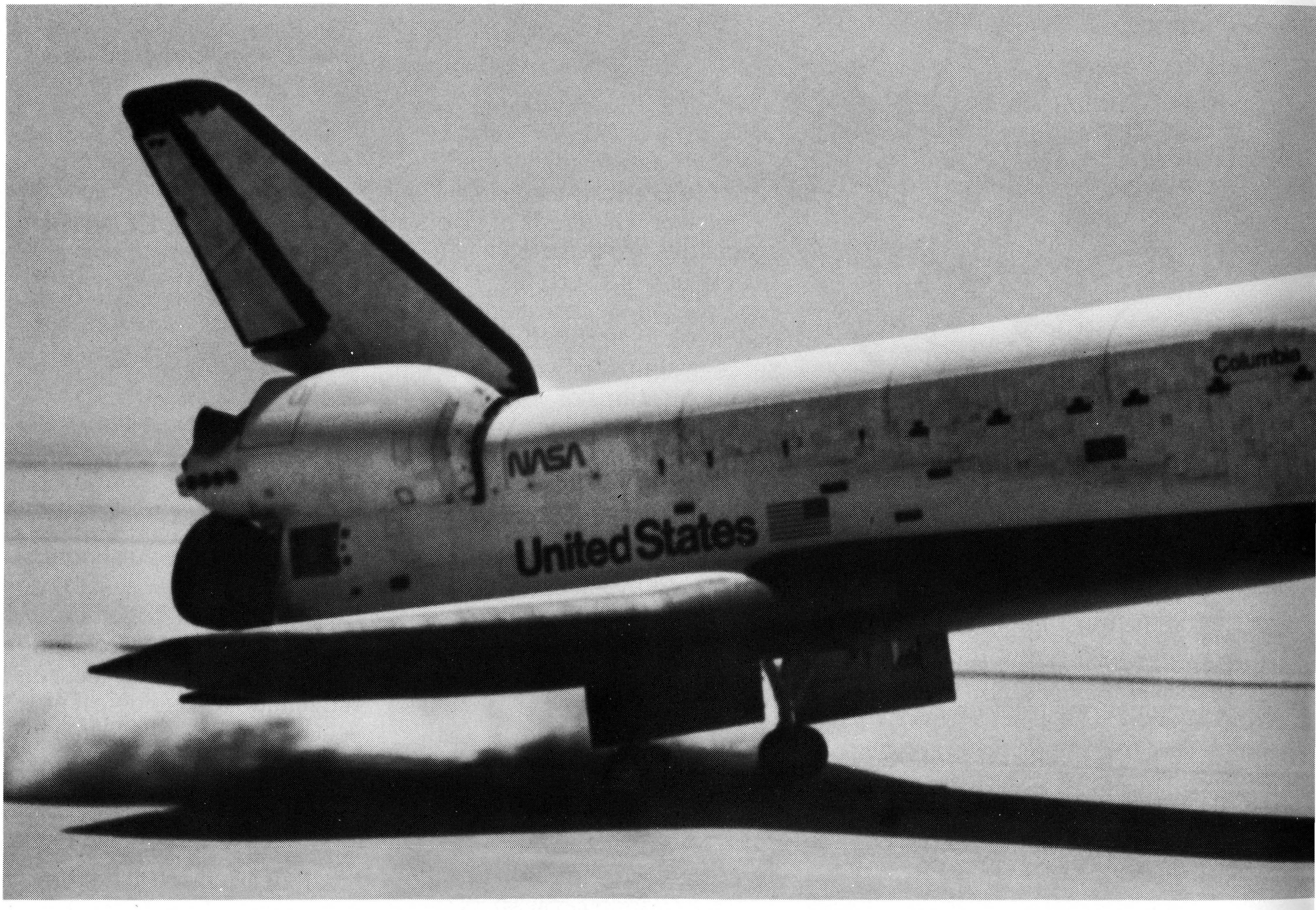


The Military's Need for Engineers

by Fred Drummond

The armed forces are looking for engineers, and apparently looking hard. an intrigued engineer might wonder how critical their needs are and what rewards exist for being hired by a service. *Engineers' Forum* talked to representatives from the Army, Navy, and Air Force to answer these questions.

A primary question posed to the service representatives concerned recruiting goals: are certain slots filled and if not, what degrees are currently sought?

Major Richard Payne of Tech's Army ROTC recruitment office said the Army is a wide open field for most types of engineers. The Army is making a concentrated push for engineers, according to Maj. Payne, in both the ROTC program and the officer candidate school for students who decide to join the Army after graduation. Engineering and 'hard science' (math, physics) graduates will have a head start over other officer applicants. Concurrently, the Army is revamping its scholarship program, expecting to see increases in the number of engineers recruited both this year and next.

The Air Force is facing a shortage of engineers at least for the near future, according to Captain William Mueller of Tech's Air Force ROTC. The Air Force has been feeling the competition from private industry in signing up engineers and does not, he says, expect to see a dramatic change coming anytime soon. Aerospace Engineers and especially Electrical Engineers are needed. Technical Sergeant Denny Thompson and Master Sergeant Ed Blevins from the Radford recruiting office expanded on the demand for EE's, calling the need "critical." Electrical engineers are needed for virtually all aircraft, weapons, space, and even biotechnology programs.

The Air Force has lesser demands for other degrees Tech offers, such as Civil Engineering, Industrial Engineering, Engineering Science and Mechanics, Materials Engineering, Mechanical and Nuclear Engineering. One degree the Air Force is looking for that Tech does not offer is Astronautical Engineering, today increasingly important as the Air Force recently created the Space Command to handle military space missions.

In contrast to the Army and Air Force, Lieutenant Brad Barth of Washington D.C.'s Naval Recruiting District says the Navy has met quotas for this year in at least two programs: Nuclear Power and the Civil Engineering Corps. They expect to fulfill next year's also. This new development is probably due in part to the Navy's college recruitment programs that pay qualified juniors and seniors who elect to serve in the Navy. Quota fulfillment does not mean the Navy has stopped looking for engineers: far from it. There will always be slots for highly qualified students. What the fulfilled quotas suggest is that there is much interest and competition for the existing slots. And, as all the services make clear, engineering demands can and do change quickly. The Navy has more than a hundred nuclear powered submarines; four nuclear powered aircraft carriers; and a small but growing number of nuclear powered cruisers, all of which require skilled engineers to man and maintain them.

For the nuclear Navy, a nuclear engineering degree is not necessary; the Navy looks for a variety of engineering and hard science degrees. The Navy trains its officers in nuclear power, theory, and operations in ;its own specialized program lasting six months, equivalent to a year-long graduate school.

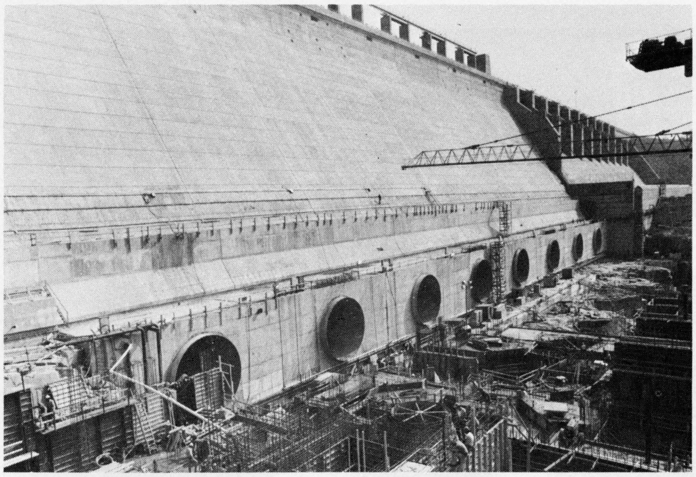
The Navy also recruits engineers for its aircraft, weapons, and regular surface ship programs; however, the Navy does not have a comprehensive college program that pays engineers in these fields.

From discussions with each service, two conclusions can be made concerning the degrees each is recruiting. First, all three services have a steady demand for CE's as each service has its own civil engineering division. Related degrees such as Mechanical and Architectural Engineering are also sought but to a lesser extent. Secondly, Electrical Engineering seems to be the most sought after degree year-in and year-out. This is due to the widespread application of EE skills to the military's programs, and makes for a broad range of jobs from which to choose within the military.

A second major question concerns what the services have to offer an engineer over private industry. The answer includes management experience, Research and Devel opment work and the engineering jobs themselves.

The Army, Navy and Air Force all stress one advantage of being an engineer in the military: management training. The services see this opportunity as their best selling point in attracting engineering recruits. Early in their careers, often as soon as their first operational duty tour, junior officers are given responsibility for managing large numbers of people and expensive projects. Similar oppor tunities in industry are rare. During an engineer's career, management abilities become more and more important in industry and the military. The services are blunt about this topic, which *could* work to their disadvantage. A person could sign up, serve four years, and then leave the military; the military really has not made good on its investment. The answer to this problem is for the military to stress the other benefits and advantages available to the military engineer in hopes of retaining that valuable individual, at least for another tour of duty.

Work in Research and Development (R & D) is often cited as a plus for joining the military. "Hands-on" experience in R & D sounds enticing; however, the paths to R & D differ among the services. The Army and Navy emphasize the concept of being an officer first and a specialist second. Opportunities for R & D work usually come up after a second enlistment. The Air Force works a bit differently, as a first termer can wind up in a "pure" R & D enviroment. This demonstrates a difference in philosophy among the services. Army officers learn to fight; leadership ability is a must out in the field. Naval officers spend time at sea, where leadership is also a must to keep the ships sailing. The Air Force relies more on equipment than the other services for its missions; the sheer quantity of technological projects and equipment requires a large contingent of engineers. Thus, the lure of R & D work does not apply equally to the three services, with the Air Force offering a more accessible introduction



U.S. Army

The Corps of Engineers also construct large scale civilian engineering projects. There work continues on the Richard B. Russell Dam and Lake (Georgia and South Carolina).

U.S. Army

Two branches of Army engineering are represented in this photo - Combat service support by the self propelled howitzer and the Corps of Engineers by the bridge.

into R & D projects.

The diversity of engineering job opportunities in the military can be an attraction of its own. What follows are some of the areas where engineers are needed, broken down by service, with a mention of the types of degrees sought for these positions.

The Army, says Major Payne, has an image problem in comparison with the other services. Potential Army engineers might be put off from an Army career because of a lack of knowledge of what the Army offers. For many observers, the main image of the Army is that of tanks and infantry, but the big role in today's Army is not just tanks and soldiers. Tanks, of course, play a big role in today's Army, but modern tanks call for engineering specialties. Electrical engineers are required to test, evaluate and maintain the M-1 tank's complex computer controlled fire system, which can track and destroy a target while the tank is on the move. Mechanical Engineers are needed to evaluate and redesign (if necessary) the actual tank, as they do for all the Army's vehicles.

Under the heading of Combat Service Support come the areas of ordnance, the Signal Corps, chemical units and aviation. Ordnance has three divisions: ammunition, automotive maintenance, and missile maintenance. The Army manufactures tests and issues ammo, and manufactures propellant for all branches of the defense Department. In the ordnance category, ME's, ChemE's, MatE's and even Nuclear Engineers are required. Automotive maintenance includes R & D as well as maintenance of the Army's wheel and track vehicles. ME and ESM are typical degrees in this area, as they are in missle maintenance.

The Signal Corps is a vital component of the Army, responsible for all of Army communications. Duties include maintaining communications from the battlefield on up the line, developing electronic warfare measures and counter-measures, and maintaining moni toring stations. Some Signal Corps officers are designated Communi cation/Electronics Engineers. An EE degree is the common ticket into this specialty, but the Army also looks for people with an " electrical engineering related discipline," and will send such officers to an advanced telecommun ications school before assignment.

The Army's chemical units deal with explosives and all aspects of chemical warfare, offensive and defensive.

A fact not normally recognized is that the Army has its own large air force. The aircraft are primarily helicopters and not fixed-wing airplanes, but the need for engineers in aeronautics and other related fields is the same as in the Air Force.

Aeronautical engineers are needed for evaluation, test, and R & D duties. Helicopter missions include attack, rescue and transport missions, all of which dictate the need for specialized aircraft. This parallels the Air Force and Navy forces of developiung a particular aircraft to perform one type of mission. The Army is accepting new types of aircraft into its inventory and is developing several others, so there is a continuing need for engineers in this field. Aeronautical engineers are also needed for the Army's extensive missle force, another branch of the Army that is often overshadowed by the Air Force. The Army's missle force ranges from small hand-launched rockets to larger types such as the Pershing II missle now undergoing tests. The army not only evaluates contracter performance on missles but also designs its own, necessitating the stability of its own engineering staff.

A major branch of the Army is its Corps of Engineers, which primarily demands civil engineers for both military construction work and civil works. The Corps is divided into four categories: combat engineering, construction engineering, topo graphicl engineering and civil works. Combat engineers are involved in battlefield warfare, removing obstacles in a battlefield, constructing obstacles to block enemy troop movements (including mine implantation), building protective shelters and aiding in camouflage operations.

Construction engineers are responsible for the building and upkeep of Army and Air Force installations in the U.S. and foreign countries. They often assist foreign governments in their military construction projects as well as the construction of towns and cities. Topographical Engineers map and survey for the Army and other services as well as the U.S Government.

Lastly, there is the Corps' Civil Works Program, perhaps most familiar to the public because of the Army's participation in disaster relief and reconstruction. The Civil Works program is more extensive than just an emergency reaction force. The U.S. is divided into Corps of Engineers Districts, for which the Army is responsible for flood prevention and control, maintenance of intercoastal water system, dam building and harbor reinforcement. Also if a community perceives a need for construction work and receives government approval and funding, the

U.S. Air Force

Air Force Engineers evaluated the General Dynamics F-16 before deciding to buy the first YF-16, modified with canards to explore new flight capabilities.

Corps can be called in to direct civilian contractors.

As stated, the Army's requirements for engineers span a variety of disciplines. If a person wishes to combine a traditional military career with engineering, the Army might be the choice to make.

Air Force engineering possibilities are themselves a sales pitch, as many engineering jobs involve work on some of the most modern aircraft in the world. Looking at various Air Force divisions reveals the scope of engineering assignments. At the forefront of flight technology is the Air Force Flight Test Center, based at Edwards A.F.B., California. Current test and developmental projects include the F-16XL "cranked wing" version of General Dynamics' F-16, the B1B bomber, and the AFTI/F-16. The Advanced Fighter Technology Integration F-16 uses canards to prduce amazing flight responses, such as flying in a straight line with the nose pointed to either the left or right of the flight path, climbing or descending without raising or lowering the nose, and turning without banking. Air Force engineers work side by side with civilian contractor personnel in exploring these flight capabilities.

The Product Organizations Aeronautical Systems Division tests and develops operational aircraft, including the F-15C and D models, the A-10, production F16's and the venerable F-4. The Foreign Technology Division, according to Air Force, "acquires, evaluates, analyzes and disseminates foreign aerospace technology. . ." Some examples of its work have been dissecting (along with the Japanese) the MiG 25 that was flown to Japan in 1976 and the less publicized acquisition and evaluation of two MiG 23's that were given to the U.S. by the late Egyptian President Anwar Sadat.

Apart from aircraft, the Air Force has a host of other fields requiring engineers. The recently created Space Division is responsible for the military use of the Space Shuttle and related space activity. The Weapons Laboratory is developing high energy laser-beam technology. Materials testing and Aero Propulsions are other research fields. Like the Army and Navy, the Air Force has need of CE's for its Civil Engineering Enviromental Development Office. The Air Force also conducts research in Aerospace Biotechnology. The primary needs for the Air Force are in the fields of electrical, aerospace and astronautical engineering.

From its ads, it is apparent the Navy sees that its engineering needs lie in its nuclear power program and its Civil Engineering Corps, though these are not the only engineering-related fields. Those are the two areas that the Navy is paying students to enter. For the Nuclear Navy, engineers and people with engineering-related (hard science) degrees man and maintain the nuclear-powered fleet of over 100 submarines, four aircraft carriers and nine cruisers. There are opportunities for nuclear power R & D - 63% of the nuclear reactors on line in the U.S are Navy power plants - but primarly the nuclear submarine officer and nuclear surface officer apply their skills to the operation of their ships. With experience in the Navy's intensive engineering applications and management, a nuclear power officer stands an excellent chance of securing a well paying civilian engineering job if he decides not to re-enlist.

The Navy's Civil Engineering Corps is similar in many respects to the Army's Corps of Engineers in the type of work done and degrees sought. Specifically, the CEC builds and maintains naval shore establishments and is responsible for managing Navy-owned lands and energy resources. There are three main fields in the CEC: Public Works, Contract Adminis tration, and Construction Battalion Operations. A Public Works Officer is similar to a city engineer in charge of a community of 3,000 to 10,000 people. Design, construction and maintenance of naval facilities, the operation and maintenance of utilities and transportation systems, and the administration of family housing are typical tasks. Contract Adminis tration is fairly self-explanatory; Naval engineering officers handle all phases of contracts with and performance of civilian engineering contractors.

Construction Battalion Operations involve buildng roads, airstrips, port facilities and the like, construction duties that are needed by the Navy to fulfill the Navy's military objectives. The Seabees fall under this field. There are also specialized programs in the CEC, including petroluem engi neering, environmental protection and ocean engineering. The Navy gives a breakdown of degree requirements for the CEC in general as follows: 60% CE's, 15% ME's, 15% EE's, 5% Architects, 5% others.

The Navy's requirements for engineers are not limited to civil engineers or nuclear power officers. As with the other services, the Navy requires its own engineers to test, evaluate and at times design its equipment; in the Navy's case equipment includes aircraft, ships and the weapons carried aloft and by sea. What the Navy does not do is pay for the schooling in these areas. Three representative Naval divisions illustrate the engineering jobs avaible in these other fields. The Naval Air Test Center tests, evaluates, and recommends modifications on new aircraft, conducts carrier suitability tests and continually modifies and updates operational aircraft. Aerospace engineers, EE's, ESM engineers and others are all hired in this area. The same engineers, as well as CE's, Chem's, IEOR engineers and ME's are needed to work at the Naval Surface Weapons Center. Engineers in many fields, including AOE's and Architectural Engineers, are sought to work in the Navy's own ship yards.

Besides the jobs aspect, there are the "traditional" military benefits to consider when deciding upon a career in uniform. Salary, allowances and benefits, postgraduate schooling, leave, health and dental care, and career stability are some of the topics recruiters like to discuss. Talking about salary can be deceptive, for an officer gets more than just a base salary. The starting pay for a secod lieutenant in the Army and Air Force or for an ensign in the Navy is about $17,000. This compares unfavorably with the average reported salary of $22,927 for Tech's 1982 engineering graduates. However, officers get housing and food allowances which are nontaxable, free health and dental care and in certain fields receive additional allowances or bonuses. All told, the total military salary is competitive with private industry. Furthermore, within three or four years (and figuring two promotions), an officer could be making $34,000 a year.

Postgraduate schooling is often available for qualified officers, who can attend military postgraduate schools or civilian universities. All costs are paid by the military. There is a catch—this route incurs another tour of duty in order that the servides get something back for their investment. As for time off, military personnel get 30 days paid leave per year. Lastly, an officer does not have to worry about career stability; his employment in the military is assured.

Most objections to a military career are applicable to engineers as well as anyone else. If travel is objectionable it would be wise to realize that the services will send you to where they have a need. Engineers, though, probably stand a better chance of remaining stateside that other people because most R & D centers are in the U.S. Civil Engineers can pretty much expect to see the world. Travel is not the most crucial issue to consider though; commitment to serve in the military is the primary concern. Engineers are not just engineers in uniform; they are officers first and are expected to be capable leaders.

The Navy, in their prospectus for the Navy Nuclear-trained officer, is upfront about military life disadvantages, and its listing **applys** to the other services as well. The Navy tells the potential recruit that the working hours are not constant, officers are on call 24 hours a day, and desired job assignments are not always available. The Navy mentions frequent family moves, and for the Navy, there are also the 6 months at sea out of 18 months while on sea duty.

For students to enter most of the military's engineering programs, enrollment in ROTC is not required. College juniors or seniors sign up with a program, finish school at their university, attend an Offecer Candidate School upon graduation and then are commissioned as officers in the active reserves. Officer Candidate Schools (the Air Force term is Officer Training School) average sixteen weeks for the Navy, twelve for the Air Force and six months for the Army. While in school, students in the Navy's nuclear and CEC programs are payed about $900 - $1100 a month and are actually active duty enlisted personnel. The Air Force has a similar program for qualified students but their program is only for seniors. The Army does not have a comparable program; instead scholarships are available through Army ROTC. There is also a $100 stipend that nonscholarship ROTC students receive.

A chief exception to the OCS route is the Navy's CEC program. A student is commissioned directly upon graduation, and instead of attending OCS reports to Newport, Rhode Island, for six weeks of Officer Introduction School. There is then eight weeks of graduate level training.

Engineers who decide upon the military in all cases can apply before or after graduation in the nonpaying programs. No obligations to serve are required until the officer trainees are commissioned. Upon graduation, the students attend the Officer Candidate school of their selected service and are commissioned into the Reserves on active duty.

The demand for military engineers exists. Specific needs vary and can change from month to month, but overall there is and will be a steady demand for engineers. What a student needs to decide is if the advantages of a military career outweigh the disadvantages. There are broad choices of engineering jobs to choose from within each service. Such jobs are in many ways no less confining than jobs with civilian engineering firms. A military engineer, though, does take on the duties and responsibilities of a military officer, a point that should not be forgotten when deciding which route to take. With this in mind, a military career in engineering could be an attractive career option.

Fred Drummond

The Naval Air Test Center at Patuxent River, Maryland, continually tests and develops operational aircraft, such as this Lockheed S-3A Viking assigned to the Anti Submarine Warfare Squadron.

A Meeting With Tradition: Research at Oxford University

by Sabrina Tuttle

For the six-month period from June to December of 1982, Ann Diggs, a senior Engineering Science and Mechanics (ESM) major, rejected the ordinary path that would complete her education in June. Although she is a co-op student, this interruption did not concern her job. Ann decided to conduct her senior research project in Oxford, England, under the supervision of her father, who is on a year-long sabbatical, working for the National Highway Traffic Safety Administration (NHTSA). She discovered both the enchantments and the inconveniences of living abroad and working in the environment of Oxford, a University where some claim is, along with Cambridge, the epitome of traditional education in England.

Arriving in late June, Ann researched in cooperation with Wolfson College, one of the newer graduate colleges at Oxford. Oxford, initiated in the eleventh century, consists of several separate colleges centralized in the town of Oxford, near the River Cherwell. Much of the design and architecture of the town is medieval — the ancient spires of the various colleges create an impressive, archaic skyline. Ann lived about a mile from town and stated that she enjoyed the "closeness of things" found in England, exhibited by the proximity to her workplace. Though she worked from nine to five each day, the pace was leisurely and she claimed that this is typical of most English workplaces — "no one got to work before 9:00." Her working day was interruped by coffee at ten, lunch at twelve, tea at 3:30, and sometimes a visit to a pub in the evenings after work. It seems that the biggest difficulty Ann experienced in relation to her job was the inconvenience of the computer system; the computers were often down and the system was archaic in comparison with the system she had been accustomed to at Virginia Tech and at her co-op job.

Ann's research dealt with the testing and formulation of an auto safety computer model. The area around Oxford is an ideal place for this type of research, Ann stated, because it consists of the variation found in small country roads and highways connecting the traffic patterns of the towns. She utilized actual auto accident data and patients' records from Oxfordshire to construct a mechanical model which tests the amount of deflection from the dashboard of an auto that a human chest can withstand. The "construction" of both the dashboard and the chest were analyzed through computer simulation.

Although she didn't study at Oxford, Ann described the high school and the university education systems in England, and pointed to some of the advantages and disadvantages that these systems contain. High school students can leave at age fifteen, after they pass their O Level tests, which are similar to SATs but on a more comprehensive level. Upon passing the tests, the students may go to work, or they may continue school for two more years, after which they must pass the A level tests. The unemployment figures in Britain account for these non-continuing students out of work, and this may have a significant effect on the high unemployment ration found in the United Kingdom. University-bound students must pass their A Levels with superior grades to be admitted, otherwise they go to work or to technical schools for further training. The percentage of students attending a university in Britain is much less than in the U.S.

The college education of Oxford consists primarily of tutorials, with an occasional lecture. Tutorials are meetings of a few students with a professor (called their "don"), and students study much on their own. This is a tradition dating to the Middle Ages, when Oxford was a meeting place for various intellectual discussion groups. Strictly scheduled lectures are not popular at Oxford, though an occasional previously unscheduled lecture given by a particular professor, is spread by word of mouth. Exams only come around once, placing quite a bit of pressure on the students. Ann claimed that while this system may be good for a liberal arts education, it leaves much to be considered in the realm of engineering. She sees the need for a lecture format and required problem-solving techniques for an engineering student, which are lacking at Oxford. Also, the computer system is not available to undergraduates, except for special cases. She views this as a very backward and inconvenient system, but admits that perhaps she has been spoiled by the more sophisticated computer utilization in the United States.

This same sort of comparative obsolescence is inclusive of the banking system in England. Ann stated that her bank at Oxford didn't use a computer system; it functioned by paperwork alone. Yet because of the smaller number of clients, the bank employees knew Ann and her father by name.

Another traditional edifice at Oxford is the Bodlian Library, where books are cataloged according to size. No orderly Dewey decimal system exists, and it may take the librarian up to two weeks to locate a book. This system is another Oxford tradition first utilized during Medieval times. To check out a book, one must not only give the name and the author, but also be affiliated with a certain Oxford College, and swear on the Bible that one will never steal a book. Checkout time is one week.

Along with enjoying the work pace (leisurely when compared to the U.S.), and the "smallness of England, Ann additionally enjoyed other British traditions, such as socializing at pubs. A pub (short for public house) seems to have no equivalent in America, perhaps a bar comes close, but not close enough. Unlike many bars, the pub is primarily for socializing and drinking, rather than a location for becoming drunk. Some people, Ann said, spend an hour or more an evening at a pub, to relax with others. The food is also good and fairly cheap. Ann mentioned the hearty "Plowman's lunch" — another relic, formerly the farmer's traditional repast, which is a cold lunch consisting of huge quantities of bread, cheese, and salad. Her favorite pub in Oxford was The Turf Tavern, a small building hidden in the nook of a side street near New College.

Ann Diggs

The skyline of Magdalen College, Oxford University.

Ann Diggs

A view down High Street, Oxford.

Ann Diggs

Virtually the first thing new students investigate at any university is the location of the nearest drinking establishment. This is a shot of The Bear Pub, the oldest pub in Oxford. It has been serving students and town residents since the 11th century.

Punting on the Cherwell River was another favorite activity for Ann. When punting, a flat, long and narrow boat is poled down the river. Once while punting, Ann viewed a nudist colony for professors. Ann also enjoyed British fashion where "anything goes."

This more ribald side of the English character is perhaps countered by the expression of Christian tradition which remains encased within the ruins and restorations of churches and chapels dotting the countryside, some dating to pre-medieval times. These structures awed Ann, and she attended several church services. She stated, "We don't even know what we're talking about when we call something 'old' in this country (the U.S.). But over there (Britain), the people don't often appreciate what they've got." At some churches, the Christmas Services have

warmed up," the Scots were immediately and apparently friendly. The capital of Scotland, Edinburgh, which is perhaps one of the most beautiful cities in the world (when the sun shines just a wee bit here and there), some of been cut back, because people come in from the pubs, drunk.

Yet the voices of the choirboys still echo in the vaulted ceilings of the cathedrals, ceilings that evoke awe, a sense of highness, according to Ann. The choirboys enchanted her, for their voices resounded beautifully against the walls of the ancient holy structures. At Saint Paul's in London, Ann viewed a service which somehow remained distant from the "busyness" of the tourists tramping through the corridors.

While in Britain, Ann travelled to Scotland and Wales also. Though the English seemed "cold at first, but then

the people were so friendly that they offered assistance without provocation. On a street corner, Ann was given directions without even asking for them. Though their beauty was tempered by the almost inevitable Scottish fog and rain, the highlands fascinated Ann. While hiking in the mountains, she and her family were drenched by rain. Ann also described Cornwall, in southwest England, as a place of especial beauty, as is the astronomical ruin of Stonehenge, which is not far from Oxford.

For thirty days she and a companion travelled over The Continent: Paris, the Riviera, Rome, Florence, Venice, Innsbruck, Salzburg, Munich, and Heidelberg were their stopping places en route. Ann is now enrolled in a Shakespeare class, and appreciates the visualization of scenes from the literature which she has experienced through travel. Even though she didn't travel through the scenic Lake District of England, her father wrote her of the beauty of the area, with special reference to the poet Wordsworth's inspiration effected by his surroundings.

Ann's ancestors are British — she saw the tomb of her ancestor Sir Dudley Digges, inside a Chapel, at Chelham. She enjoyed exposing her roots; it was another one of those "awesome" experiences the atmosphere of Britain seems especially adept at producing.

Ann had to sacrifice a lot in order to research and travel abroad. Some were elemental things, such as missing the conveniences of a shower or a toaster — like many Americans, she discovered how spoiled in this respect she is. Other sacrifices were emotional, such as missing her boyfriend or missing the football season. Academic rearrangement is another problem for Ann — she must go to school an extra quarter next fall, after many of her friends have graduated. In spite of these difficulties, Ann thinks it definitely was a worthwhile experience, travel she might not be able to do after the restrictions of the working world entangle her. Quite emphatically, Ann exclaimed, "I loved it — I want to go back so badly I can't stand it!"

Sabrina Tuttle is a senior majoring in English. This past summer she spent two weeks at Oxford as part of Tech's Study Abroad Program.

Engineers' Week: 1983

Bob Daniels

The Student Engineers' Council hosted its second annual Engineers' Week from February 20-26.

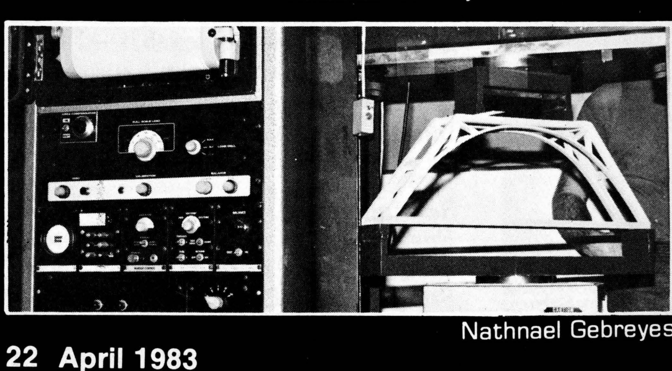
Events included seminars, contests, entertainment and company sponsored luncheons.

Challenging

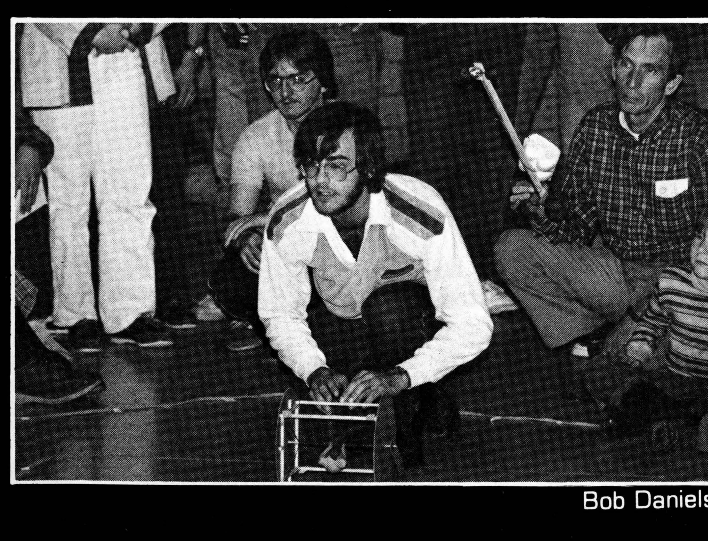
left - Truss competition winners from left: Mike West and Don Licht (third place),Paul Shirley (first place), Randy Holmes (second place).
bottom left - Truss structure being tested to its limit.
bottom right - Erann Gat prepares to launch his vehicle in the Egg Car race.
right - Egg Drop Contest.
above - Becky Abbott roasts Dean Paul Torgersen.

Niall Duffy

Nathnael Gebreyes



Nathnael Gebreyes



Bob Daniels

Entertaining

right - Assistant Dean Osborn (left) and professor Pierce listen as the Dean gets his turn.
far right - The Egg Drop Contest is closely watched by the organiser, Amy Dare.
lower right - Students attending luncheon sponsored by the U.S. Air Force.
below - Inez Pridgen dances with Mark Tewell (not shown) at student faculty mixed.


Bob Daniels

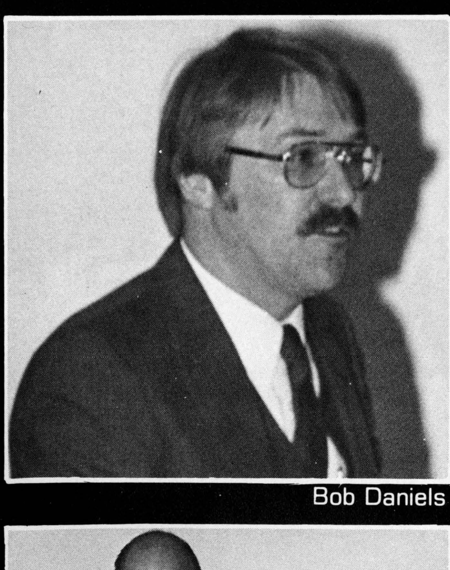

Nathnael Gebreyes

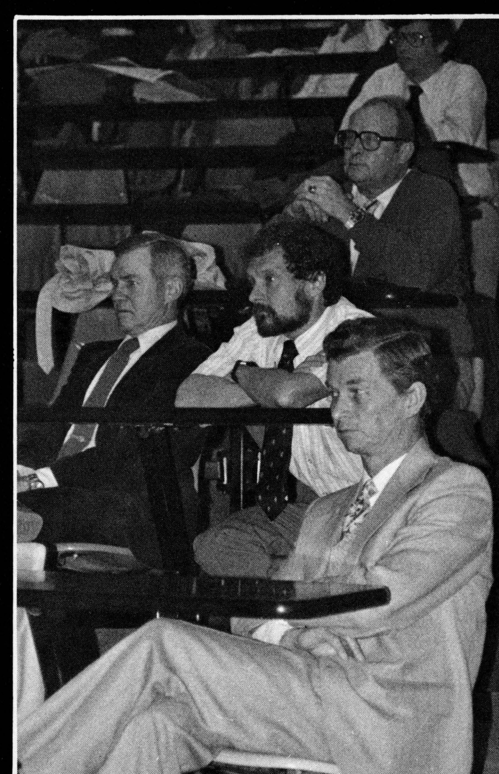

Bob Daniels


Bob Daniels

Educational

left - John DeBell, President of the Virginia Society of Professional Engineers.
right - Students and faculty listen as John DeBell speaks on the role of the engineer in society today.
lower left - Hans Cherney speaks at the PACE conference.
below - Valdemar Bodin speaks at The PACE conference.


Bob Daniels


Bob Daniels


Bob Daniels

Bob Daniels


FRUMPLES
Hey, don't I Know you? you're the Chemical Engineer they wrote about in the Forum, right?
Yeah
Wow.. What do you do, like, invent new Chemicals? Could you, you Know, design some chemicals for me, man? heh heh
Well, actually that's a common misconception.. I don't---
Hey Larry, Betcha don't got yer own designer 'phetamines, man!!
Greg Osterhaus 1983
WOODARD