Engineers' Forum

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Alan Weston's Hybrid Vehicle in the Himalayas

Engineers' Forum

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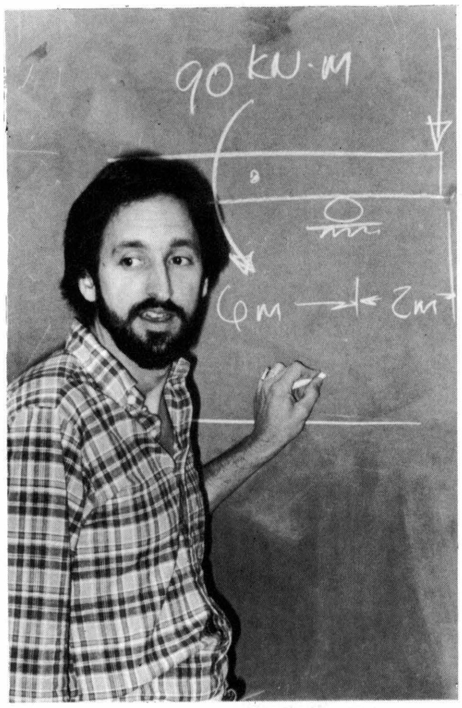
Richard Goff—1982 Sporn Award Recipient

by Fred Drummond

"I look at teaching more as a joint adventure in some particular area rather than as a transmittal of information--I try to keep the classroom like that," states Dr. Richard Goff, assistant professor in Engineering Science and Mechanics. Many engineering students appreciate Dr. Goff's approach and attitude, and in recognition of his teaching abilities have awarded him the 1982 Sporn award in engineering for teaching excellence. The word most commonly mentioned in regard to Dr. Goff by present and former students is "enthusiasm;" he likes people and enjoys teaching, attitudes readily conveyed to his classes. With his zeal for teaching, it is suprising to find that he seemingly "backed into" the teaching profession.

After receiving his bachelor's degree in Aerospace and Ocean Engineering at Tech in 1967, Dr. Goff did not rush headlong into graduate school and the teaching profession. Instead, he worked as a civilian for the Department of the Navy in the field of aircraft composites, a period which was broken up by a two year stint with the Peace Corps in Micronesia, where he "worked on water systems, low cost housing, things like that." At the time, he did not see his motivation for working in the Peace Corps only as a way to help people through engineering, though that was certainly a factor: the adventure of living and working in Micronesia was preferred over the grind of applying to and then attending graduate school. In a step even further removed from the academic world, Dr. Goff managed a motorcycle shop for three years. Nonetheless, he could not be kept away from school, especially when in 1974 Tech called him to see if he would like to become a graduate student in AOE, where he went on to receive both his masters and doctorate degrees in aerospace engineering.

After two years as a graduate student, Dr. Goff became an instructor in AOE. He has taught one year as an instructor in ESM, and while a PhD. candidate held a joint appointment for one year in AOE and ESM. Upon completion of his doctorate degree in August of 1981, he became an assistant professor in ESM.



Teaching in ESM allows Dr. Goff to reach a wide range of students, from the many different engineering fields to non-engineering areas like architecture. "The thing I really want to do in engineering," says Dr. Goff, "is to take it out to the masses, so that engineering isn't just a 'black box' like computers are . . . I'd like to expose to more people what engineering is about." This goal shapes his teaching method. "Initially I deal with (the students) as people, we're all in the same boat, we're all on this planet together--that's where I start," he says.

To this end he makes a conscious effort to know his students. "You really interact with people differently once you get to know them a little bit," he says. "I try to get to know all the students in my classes to some extent." He finds summer sessions, with about 23 students in a class, easier in this respect than the regular school quarters. During the summer, he can generally learn everyones' name in two days. For a regular quarter, he can learn about half the names quickly, but says it takes perhaps the rest of the quarter to get all of the students names.

Asked to expand on his teaching methods, Dr. Goff states, "I do some lecturing (but) I really don't like to lecture at all. I think people learn from experiencing what's going on, doing excercises, quizzes, answering questions, asking questions, and being involved in an interactive kind of learning. I don't think just standing up there and putting stuff up on the board is instructive by itself, although some stuff has to be given that way." In Dr. Goff's view, the facts in a course are a given; whether the learning is to be a dull experience or not depends on the instructor. Dr. Goff's position is not hard to decipher. "I feel that learning should be an enjoyable experience and try to create that kind of atmosphere," he says. The key then in Dr. Goff's teaching style is to make sure engineering is not isolated by itself, but to make connections between engineering and people. It comes as no surprise then to find out that his interests outside of engineering involve people too.

One of Dr. Goff's major concerns apart from teaching is the Hunger Project, a non-profit organization dedicated to eradicating world hunger by 1997. The Hunger Project was created in 1977 by Werner Erhard and others who see worldwide hunger as a soluable problem. As Dr. Goff explains the motivation and methods behind the project, "Hunger doesn't persist on this planet because we can't do anything about it, it persists on this planet because we don't have the will to end it." Erhard "created a context that the end of hunger and starvation is an idea whose time has come. The first thing you need to do when you're going to tackle anything is to create a context for that (project) to occur in."

A prime example of creating a context for a project is John Kennedy's pledge that the United States would put a man on the moon by the end of the 1960's. Kennedy provided the impetus needed for the moon landing program, and "if he had not done that, we probably would have never gotten to the moon in ten years-he created a context for that to occur in. Once the context is created, then people will do what has to be done to get the job done. And as you saw, we got to the moon, and that's what's being done in the Hunger Project." *(continued on page 20)*

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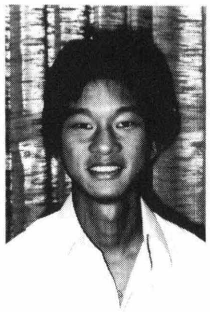
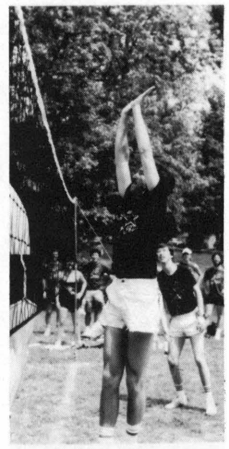


SEC Superstars competition took place on May 15 when the various engineering societies challenged each other in softball, volleyball and tug of war. In the men's division, ChE took the overall number one spot, followed by AOE and ME. In the co-rec division, where each team had to have at least five women in its squad, ME triumphed, with Che and IEOR rounding out the top 3. Director Johnny Harimoto kept the event within budget despite the seemingly endless supply of hotdogs and hamburgers cooked up for all in attendence.



Luncheon Program

The Sec will continue its program of company sponsored luncheons. Companies host these luncheons at the Marriott Inn for about 50 students to explain the companies' programs and goals in a relaxed and informal atmosphere. Randy Culver is this year's program director.

Homecoming Queen Candidate

Barbara Swoboda, a senior in Industrial Engineering and Operations Research, has been elected Student Engineers' Council's candidate for Homecoming queen. The Student Engineers' Council is the only organization on campus to have candidates make the homecoming court two years in a row.

expo 82

This year's engineering exposition, EXPO '82, offers something for everyone. On October 13 & 14, companies from across the nation will display the latest in technology in everything from agriculture to aeronautics, microprocessors to mechanics, tiny hand held calculators to huge computers.

A walk through EXPO '82 gives a peek at tomorrow. Talking computers, model power plants, the latest nuclear submarine design and new irrigation methods are only a few of the sights one can expect at the EXPO. Walking through the EXPO ballrooms you might see defense systems, food processors, new polymers and textiles, new energy sources, robots, a home computer system, and much more. Last year's EXPO brought technology so recent and innovative, in one case it wasn't even permitted to be televised.

The EXPO is more than just the most interesting technology showcase to be seen at Virginia Tech. EXPO '82 offers students a chance to meet people--company representatives who will take the time to help you with your career. These representatives can advise you on courses of study and give you an accurate picture of job opportunities with their company. (See "Making the Most of Your Plant Trips.") EXPO offers an invaluable opportunity for graduating seniors, prospective co-ops, and summer job hunters to find out where the openings are.

EXPO '82 is the result of months of planning from students in all disciplines of engineering. A series of phone calls, followed by hundreds of mailings, gives companies all the information on EXPO they need to start planning their display. Final preparations include distribution of publicity items--everything from posters and tent cards, to T-shirts and balloons.

Door prizes from local merchants as well as participating companies add to the excitement of the EXPO. EXPO '82 should be one of the biggest events held on campus, with coverage by local T.V. stations, radio stations and newspapers. EXPO '82--a technology showcase of today and tomorrow.

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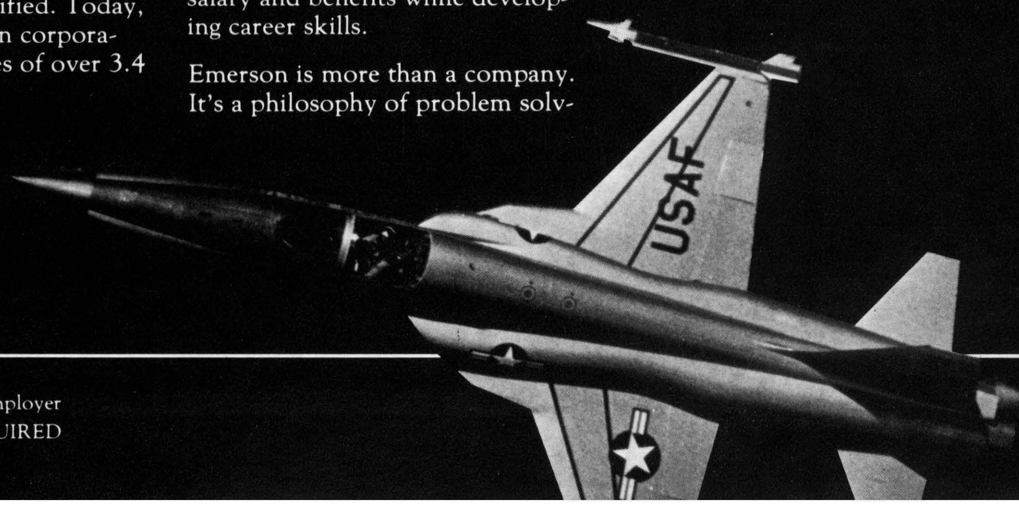

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Chris Kraft—
Life at the Launching Pad

When Chris Kraft graduated from Virginia Tech in 1945, aeronautical research was beginning a new and revolutionary phase: the exploration of supersonic flight. In 1958, while working for NACA, Kraft found himself entering another era, the space age. This past June, while visiting Tech as the commencement speaker at graduation, Kraft recounted those days and his career as the voice of Mission Control.

Chris Kraft was a two-year old boy when the first liquid-fueled rocket was fired in 1926, launching America's space age. The American Robert Goddard, who sent the rocket 41 feet into the air for 2.5 seconds, was feared by his neighbors to be a mad scientist who was endangering their lives. Consequently, a compatriot, Charles Lindberg, helped Goddard secure financial backing to move from his New England farm to an isolated area in a southwest part of the country in order that he might continue his work without interference.

In less than half a century, Goddard's work would provide the basis for spacecraft orbiting the earth, landing men on the moon, and making journeys to distant planets. Chris Kraft would be directing those flights, and he too would be facing problems similar to Goddard's, only on a national level. And he would be facing political opposition from such people as Senator William Proxmire, who as head of the 1977 Senate subcommittee responsible for the funding of the National Aeronautics and Space Administration (NASA), would say that he did not want to see one penny go for this "nutty fantasy" of space colonization. Kraft has learned to take these comments in stride, retorting today, "Proxmire is one of those types of humans who is required in our form of government and life. He fancies himself as a protector of the public's coffers . . . and I think that we all recognize that he is good for us, like castor oil."

When Kraft graduated from Virginia Tech's Corps of Cadets in 1945 as an aeronautical engineer, he never suspected that he would be explaining his work to millions of people. He admits he was not what he would have labeled "prime engineering talent." He was an athlete at heart, enjoying most sports and playing varsity baseball for Tech during his junior and senior years. His fifth floor office overlooking the Lyndon B. Johnson Space Center which he continued to direct until his retirement this past August, contained many reminders of his allegiance to sports, including one autographed picture from Joe Namath. The former New York Jets quarterback writes, "Dr. Kraft, you doubted my ability to lead my team to the Superbowl, but I never doubted your ability to take this country to the moon."

High school teachers and college professors led Kraft to his choice of engineering as a profession and aeronautics as a specific career. He remembers math teachers that he was particularly fond of during high school and a physics instructor who challenged his abilities. This groundwork paved the way for his entry into Tech's College of Engineering. During this third year at Tech he met Lee Seltzer, who started the aeronautics department and Frank Mahrer, now a retired professor of Engineering Science and Mechanics. "They impressed me with their capability to educate people and their enthusiasm for aeronautical engineering as a result."

When Kraft graduated, it was "a super time to enter the world of aeronautics because the aerodynamic design of World War II airplanes was based on the research done in the 1930's. After the war, the late forties served as a beginning for new designs," he says. Within a year he was working for the National Advisory Committee for Aeronautics (NACA) on what the laws of physics described as the impossible: designing an airplane that would fly faster than the speed of sound. "My professors had proven to me that it was impossible, and the world's leading aerodynamicists agreed with that conventional theory, which was based on the laws of physics and mathematics," he says. In 1946, *'I had no idea that I would be on television half the time . . . and forced to explain my actions in detail to the press everyday'*

the X-1 became a reality and the laws of modern aerodynamics had to be reevaluated.

Kraft worked for fourteen years on the flight testing of airplanes. He can recite all "those numbers you've never heard of," as ones he helped to design, including the P-51, P-47, P-39, P-61, and F8F. "It was a great education that I received during those years as part of the flight test organization for the control of airplanes . . . which allowed transonic and supersonic speed with automation. It is now the central core of research needed to make today's modern airplane."

A new direction in Kraft's career came as a result of the Russians launching Sputnik 1 in 1957. "This served as a signal to the world of the capabilities of having something exist that could fly over and observe your actions every 90 minutes, and then transmit signals on its observations. This was the challenge to us which brought about the creation of NASA in 1958, the nucleus of which was NACA," the man who calls himself the "world's oldest space cadet" says. He was one of 23 engineers comprising the NASA organization, about to embark on the ideas of a manned spacecraft.

"Frankly, this was the first experience in my career which challenged me to do something time-oriented from the press of a schedule; to do something that was development-oriented as opposed to plain aeronautical research; and something that was of high importance in terms of prestige to the country. I don't believe any of us realized the magnitude of what we were doing in terms of its importance in the media. We took it on as a challenge to the country's technology and capability. I don't believe we comprehended the impact it would have on the country or the world."

The impact which the space program had on the country was indeed underestimated at the time, but so was the effect that it would have on Kraft's life. "I had no idea that I would be on television half the time as a flight director for Project Mercury, and forced to explain my actions in detail to the press everyday," he says.

Kraft found the intricacies of dealing with the press and the media while trying to solve a very tough technological development problem to be quite a combination. "We were in a whole new world of man's relationships in space that were totally unknown to most people and a very mystical set of new sciences. To educate the general public became a real challenge, and I must admit we probably didn't understand it ourselves," the engineer says. With the addition of astronauts "it became one hell of a problem" dealing with the press who wanted to "dissect the human aspects of the space program," he adds.

Yuri Gagarin, a Russian, was the first person sent into space. Several weeks later, on May 5, 1961 U.S. Astronaut Alan Shepard completed a successful mission, spending 15 minutes in a suborbital flight directed by Kraft. During that same month, John F. Kennedy challenged the country to land a man on the moon and return him safely to earth within the decade.

Kraft recalled this challenge during his commencement address at his alma mater this year, saying, "With all due respect to the memory of John F. Kennedy, I must tell you I thought the man had taken leave of his senses. We had never even placed a man in orbit. And yet, here in front of television cameras beaming his message all over the world was the President of the United States committing us to a lunar landing."

Many technical problems faced Kraft and NASA as a result of that announcement made by the late president. Could a man function under the G-loads imposed by a booster rocket powerful enough to get the astronauts started on a half a million mile trip? How would the astronauts react to the absence of gravity for such long periods? How would NASA keep them alive in a vacuum? Could they navigate a spacecraft away from the earth's gravitational influence, across a quarter of a million miles of space to a place no one had come any closer to?

The answers seem simple today, but in 1961 it left Kraft "dumbstruck" by the challenge. But one thing was in his favor during the sixties when he was the director of the flight operations -- there was a national commitment to this cause. "We had financial problems. We had people problems, and we had horrible experiences that we had to deal with, but they were not the frustrations that we have now. Then, we had the people in the science community and the world of politics who did not believe we could do it, but the great majority of the public, the congress and the presidential administrations we had during that time period were very supportive of the goals we had set and had no intention of withdrawing their support."

The seventies was a different era for NASA and Kraft who became the center's director. The space center went from 4800 civil servant employees to 3400 people today. A contract force in addition to the regular employees dropped from 12,000 to 5,000.

Kraft had to weave his way through a very delicate political situation and scratch for the money he obtained in order to make sure the space program was not relegated back to a research and development mode as opposed to the operational mode the space shuttle provides for the country.

When he speaks of administering NASA during that time period of readying the space shuttle for flight, he says he won his toughest political victory, but one which also created "hell" from a public relations viewpoint. As he explains the situation, he slips into his aeronautical engineering background reporting, "We never had enough money. We were always 10 to 15 percent behind the power curve relative to money." As he realizes what he says, he laughs, and admits, "I can't get away from it."

Continuing his story, Kraft describes how NASA would prepare a program and budget for the year, "knowing damn well there would be technical problems and it would have to be reshaped . . . We did this because we knew we couldn't make waves or we were apt to lose the whole program . . . The Watergate affair and Vietnam had the country very much opposed to government spending and government intervention . . . The press were down on the space program because they

(continued on page 20)

Program, Program (Input, Output)

by Edgar W. Pope

I would like the world better if it were a stage. At least that view of things allows for some spontaneity on the part of the actors. However, we must accept the world for what it is. My conviction is that the world is a computer, and that what I call myself or my consciousness is a program that happens to be running at the moment; that I was written and compiled ages ago by some bored and possibly inept Programmer, who loaded me into my ancestors' genes and, at a predetermined moment, commanded me to Run; that I am quickly using up my allotted milliseconds of computer time, and that I will soon be terminated, my life and all its output committed to the cold and remote magnetic tapes of Memory.

But this is ridiculous, you say; all I have to so is look at myself, pinch my arm, bite my lip, to know that I am a flesh-and-blood human being and not a crowd of electrons whizzing around inside a machine. Well, if that is all it takes to convince you of your physical existence, I envy you. It isn't that easy for me. What happens, after all, when I look at my hand? I experience a sense impression; I am aware of the visual image of a hand. But I can only speculate as to what lies beyound this sense impression. There may be a physical human body out there with a solid, flesh-and-blood hand that reflects light into a real pair of eyes. But this is only a hypothesis, a guess that I might make in an attempt to explain my sense impressions. There are other possible explanations, and the one that I am convinced is most accurate is this: the impressions of physical objects, my hand for example, are manufactured by the great program of my consciousness. The Programmer, Whoever or Whatever he may be, feeds in the necessary data--the shape, color, contours of the hand--and at a predetermined moment of my existence, the program transforms this data into the image of a hand, which it projects onto my mind as onto a movie screen. So it is with all of my conscious experience: all of my thoughts, perceptions and emotions are simply the results of the processing of different types of data by different procedures and sub-procedures within the great program.

You may wonder how I ever began to think such thoughts, much less believe them. I agree, it all sounds incredible at first. My convictions came upon me rather suddenly, and it is difficult for me to say exactly what led me to them; but perhaps you will better understand my beliefs if I give you some account of my life up to the time of my realization.

Like you, I once believed that my flesh was solid and that my thoughts and decisions were the products of my own mind and will. I was a great believer, in fact, in the creativity and spontaneity of the individual, particularly in my own creativity with language. From childhood I wanted to be a writer. I used to jot down poems while sitting in the back of the classroom, ignoring the teacher; I would stay up late at night in my room, feverishly pouring out prose. By the time I was sixteen I had finished a novel, dozens of short stories, and probably hundreds of poems. Yes, at the time I thought I was very creative. That was before I realized that all of my scribbling was only program output such as might be generated by a few lines of computer code:

```
WRITE (POEMS);
WRITE (STORIES);
WRITE (NOVELS);
```

My mother was delighted with my literary efforts. She rarely spoke a sentence to me without encouraging me to keep writing and telling me how proud she would be when I won my Pulitzer or Nobel Prize. My father, being the practical minded man he was, took a very different stance. As soon as he saw that I was making A's in my math classes, he began hounding me to forget about all this dreamy-eyed literary nonsense and set my sights on a practical, down-to-earth, lucrative scientific career. Computers, he advised--the up and coming thing. Very predictable, my parents: beginning when I was a teenager and continuing until the present, both of them have talked to me constantly, constantly about my future, and neither of them has wavered from his initial stance. Like constants declared at the beginning of a program, their values will never change.

```
CONST
    MOM=mysonthepoethow
wonderfulhowwonderfulto
writesowonderfullyandifyou
keepatitkeepatitkeepatityou
willbefamoussomedaymyson
thepoethowwonderful;
    DAD=poetshmoetwoullbe
onwelfareallyourlifeyoullbea
bumyoullbelivingoffmyhard
earnedpaydoyourmathgoto
collegegetajobmakesome
moneysomehardearnedhard
hardearnedhardearned;
```

Those are my parents. You now know them as well as I ever did. Impossible, you say; how can I reduce the infinite complexity of a living, breathing human being to one character string, a few lines of a program? The answer is that I am not talking about living, breathing human beings. I am talking about my parents as they have existed in my life; they have existed in my life only as impressions on my senses, emotions and thoughts; and what exists in my senses and emotions and thoughts is, as far as I know, all that exists. The notion that my parents are flesh-and-blood human beings is simply a guess, and one for which there is absolutely no supporting evidence that I can see. In short, my parents, like other so-called human beings, are nothing more than collections of data that the program of my own consciousness makes use of from time to time. Thus, it is quite accurate to represent them as sections of computer code.

'Of course the whole thing seemed marvelously spontaneous and magical to me at the time . . . before I realized that love is, after all, only another subroutine'

But, to return to the story of my . . . life, as you would no doubt prefer to call it. I graduated from high school a year early, straight A's, scholarships, and went off to college. There I continued to feel the parental forces pulling me toward the opposite poles of science and literature, toward security and routine on the one hand, toward uncertainty and spontaneity on the other. I compromised, and worked toward degrees in both computer science and English. I would work math problems and punch the keyboard of a computer terminal half the day, and spend the rest of my time reading and writing.

Well, not all of my time. I was afflicted with the usual yearnings of the young, and without quite knowing how it happened I soon found myself spending a great deal of time with a certain lovely collection of data named Elsa. For several years Elsa and I carried on a love affair, complete with all the emotional and physical processes that are implied by that phrase. Of course the whole thing seemed marvelously spontaneous and magical to me at the time. That was before I realized that love is, after all, only another subroutine.

And so, what with scientific, literary, and other types of activity to fill up my time, the years rolled by as quickly and inexorably as the statements in a FOR loop.

```
FOR YEARS:=1 TO 4 DO

BEGIN

LOVE(ELSA);
READ(BOOKS);
WRITE(PROGRAMS);
WRITE(POEMS);
WRITE(STORIES);

END;
```

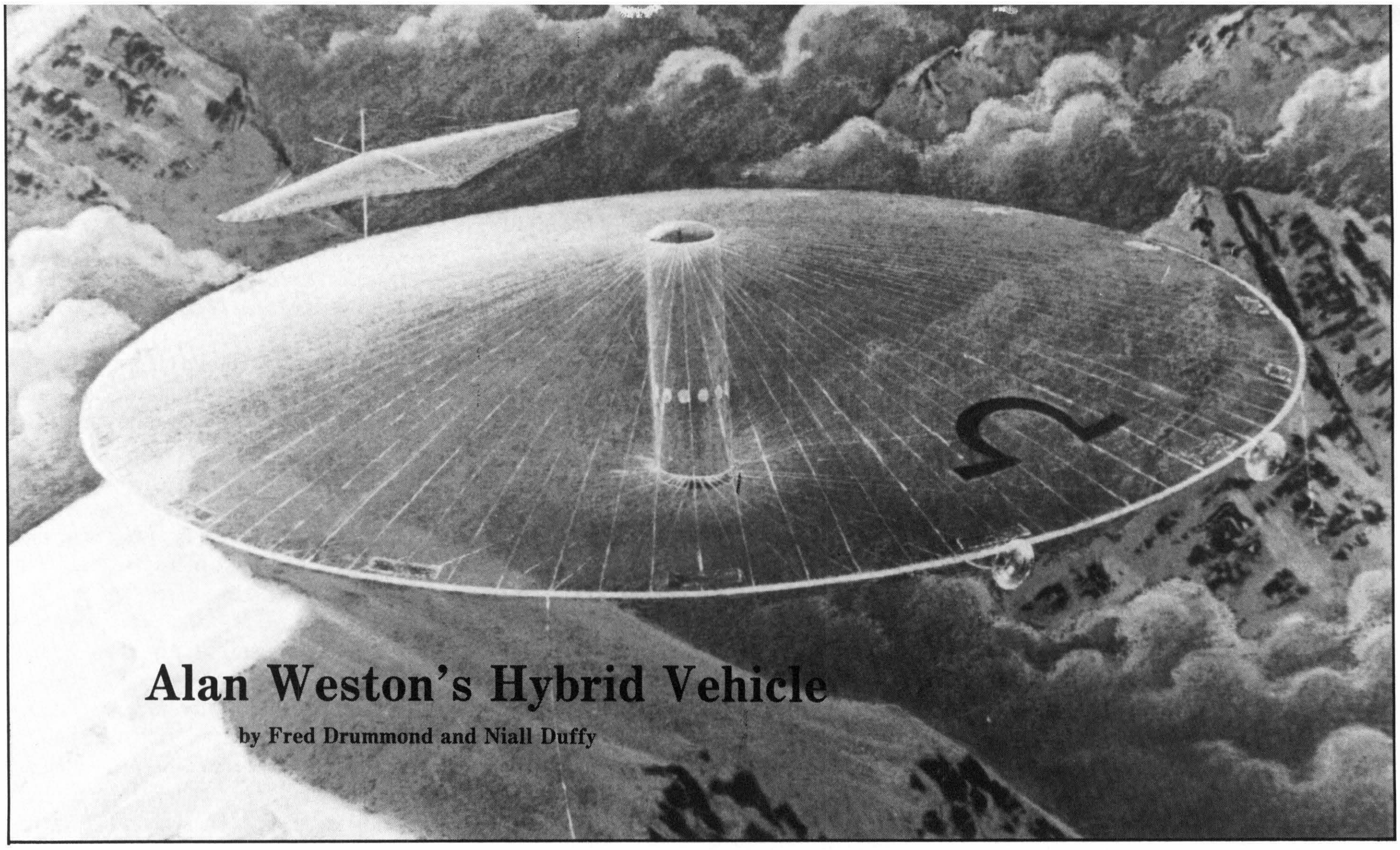
Then, during the last semester of my senior year, the revelation came. It was four o'clock in the morning and I was working on a program; I had been working on it for days without sleeping, keeping myself going on potato chips and Pepsi. I was staring at the green and white lines of a printout, and suddenly I began thinking about the absolute, mechanistic certainty of a cumputer program, the way it flows rigidly and unswervingly from a clearly defined beginning to an inescapable end. And then I thought of my own life: of the rigid and unswerving forces exerted on me by my parents, my urge to write, my sexual needs, my desire for financial security; I thought of the poetry and prose that seemed to flow from me of its own accord, the math problems that seemed to solve themselves, the A's that appeared on my grade reports as if by magic, pulling me mechanically from one grade to the next, all seemingly the work of an unseen hand--and suddenly I knew: it *was* an unseen hand, the inscrutable hand of the Programmer who had planned out the course of my life, typed me in on a terminal or a deck of cards, compiled, loaded, and run me on an equally inscrutable Computer. I decided that I was probably not the final version of his program, given the imperfections I could see in myself; I was probably still in the debugging phase. But, be that as it may, my sudden awareness of the Programmer's existence, and of my own true identity as a piece of software, overwhelmed me like a sudden surge of electricity. The true order of the universe revealed itself to me in a flash (that is to say, the Programmer fed me the data that was needed for this relevation), and I saw my own place in that order and the destiny I had to fulfill.

I promptly set about fulfilling it. After receiving my diploma, I took the highest paying job I could find as a programmer, gave up writing forever, politely told Elsa to get lost, moved into a rat-infested basement apartment, and began saving my money. My mother was horrified that I had dropped Elsa, who she always thought was a nice girl, and still more horrified that I had given up writing. My father was delighted at my choice of employment, though somewhat mystified by my choice of accommodations. Both, however, were equally flabbergasted when I quit my job, bought my own private computer system with the money I had saved, moved it into my basement apartment along with twenty cases each of potato chips and Pepsi, and locked the door behind me.

It's quite easy to explain, really. Up to this point, I now know my life has been a purely mechanical execution of the Programmer's code: writing, making love, tying my shoes, deciding what to make for breakfast, everything happened with preprogrammed precision. The rest of my life, will of course, be the same; I myself am the program, there is no escape. And yet it is still possible to assert my freedom. Freedom! you say. Surely my whole philosophy is a denial of free will. Only free will in the absolute sense: freedom, I have come to realize, is entirely relative. The Programmer who planned out the events of my life so carefully--or carelessly, I'm not sure which--is himself undoubtedly a program, written by a still higher Programmer; and yet the Programmer who programmed me posseses a kind of freedom with respect to his program, myself: it is he who constructed me and made me work, according to his own design. That design, of course, is part of a still higher design that encompasses the Programmer and all his programs, including myself; but considered only in relation to his program, the Programmer is in control, and is, in that sense, free.

Having reached these conclusions, I set out to grasp that portion of freedom that is allotted to me in the universal order. After only five cases of potato chips and three of Pepsi, I have already written a program that is born, goes through school (only high school thus far), reads a few books, has one short love affair, and finally writes its own program. The next step, of course, is to develop this latter program--the program written by my program--to the point where it, in turn, writes a program of its own. Where does this all end? you ask. Actually you don't ask at all, this "you" to whom I have been addressing myself is nothing but a line or two of input data, but I'll answer the question anyway: it ends whenever the Central Processing Unit decides to stop it.

END. ■



Alan Weston's Hybrid Vehicle

by Fred Drummond and Niall Duffy

In the not too distant future, if people claim to have seen a flying saucer passing overhead, they may not be suffering from hallucinations induced by swamp gas. Alan Weston, a doctoral candidate in Aerospace and Ocean Engineering, in conjunction with friends in England and America, has designed a disk-shaped craft that recalls the UFO "photos" of the fifties. The purposes of the project are multifold--to explore hybrid vehicle technology, to investigate potential economic factors of such a craft and to transport hang gliders across the world. Alan and his friends are dedicated hang gliding enthusiasts who have a strong desire to fly off Mt. Everest; they hope to fly there in style while conducting hybrid vehicle research.

Alan's friends have grouped together under the name of the Dynasoar Project to design their craft, Omega. The craft is part airship and part airplane, hence the term hybrid vehicle. An airship, or lighter-than-air (LTA) craft, obtains lift through bouyancy, usually by means of a gas like helium. A conventional airplane, or heavier than air (HTA) vehicle flies by generating aerodynamic lift. Omega incorporates both methods to fly. Helium will fill the main portion of the saucer-like craft, providing bouyancy, while the circular shape of Omega is itself an airfoil that will provide aerodynamic lift. (See technical details on opposite page.)

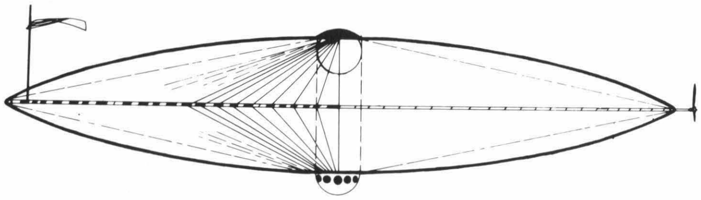
Airships have recently undergone a revival as people search for cheaper, more productive means of carrying out certain tasks done by airplanes and helicopters. Airships do have some drawbacks, control during landing being a prominent example. To see if a hybrid vehicle with aircraft-like control capabilities, holds advantages over airships is one goal of the Dynosoar Project. Airships need to be hauled down when coming in for landing; they sort of float down to the ground and then are reeled in by ground winches. The Omega lands like an airplane. It sets up a landing approach and then lands on a runway. Because it is a slow moving craft, Omega is a short takeoff and landing (STOL) aircraft, meaning it needs little runway length, and it can operate from any cleared space. Unlike a true LTA craft, Omega will not be fighting its own bouyancy when landing.

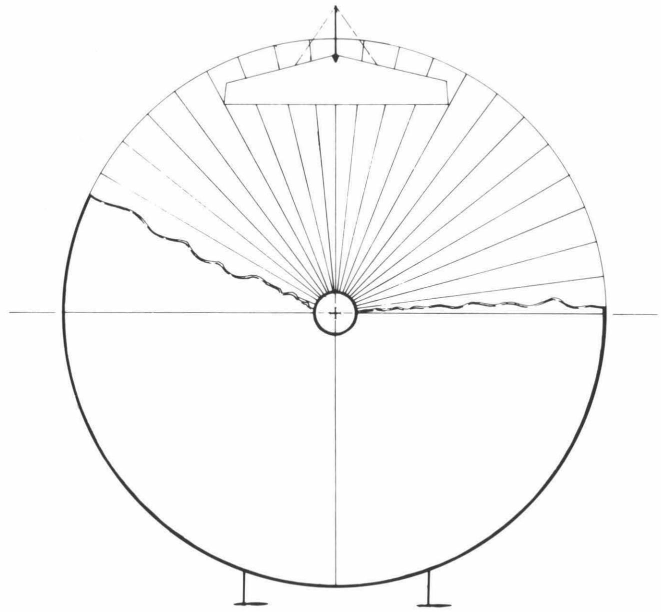
The technical details and questions posed by hybrid vehicle research are serious scientific and engineering motivations behind Omega, but as stated, the Dynasoar group members envision a dual role of their vehicle. They are serious about the possibilities of using Omega to further their sport of hang gliding. Knowing the interests and previous projects of the group helps explain certain features of Omega, specifically its shape, high altitude capability and long range.

The resemblance of Omega to a flying saucer is strictly intentional. Novelty and unconventionality are the key concepts here, which also underlie many of the interests of Alan's friends. Novelty and the idea of doing something out of the ordinary led Alan and some friends into bungy jumping. What is bungy jumping? TV watchers might remember an episode on ABC's "That's Incredible" where a group of people attached themselves to what were essentially long rubber bands and then jumped off bridges and sprang back up. That group consisted of Alan and his friends. The rubber bands had harnesses into which people strapped themselves. They then leaped off a bridge and bounced back up where they were caught and pulled back to solid footing by their compatriots. Questions of sanity and madness spring to mind over this sport, but the inclination for jumping off of things also influenced the friends' sport of hang gliding.

In telling of the events that led to the creation of Omega, Alan related some experiences he and his friends underwent in hang gliding. All the members of the Dynasoar project are experienced and dedicated hang gliding enthusiasts, who travelled to Africa in pursuit of the perfect flight. England, the home of most of the members is not renowned for high mountains, so the group made an excursion to Africa several years ago to fly off mountain tops. Their trek took them to Mt. Kiliman-

Technical Considerations





The key to the design of the Omega is innovation: testing new concepts in design and technology. The performance goals are as unusual as the design. The objective is a vehicle with high altitude operation, extreme low speed, and transworld flight capability. The intention is to study the economic feasibility and performance characteristics of this unusual craft.

As far as the structure of the craft goes, imagine a bicycle wheel, without the tire, lying horizontally. Scale up the wheel so that it has a diameter of 150 feet. Replace the wheel's metal hub with a foam/fiber glass tube, 30 feet in height, which becomes the crew compartment. Connect the aluminum rim with carbon-graphite wires instead of the steel spokes of the wheel. Cover the craft with a polyurethane film, add a canard wing to the front, and power the craft with two Volkswagen engines.

As indicated by the term hybrid, the lift of the craft will be derived through a combination of two sources: bouyancy and aerodynamic lift. Bouyant lift will be achieved by containing large volumes of helium and hydrogen; hydrogen is preferable because of its lower cost and lower density, but it is also highly flammable. Since the Hindenburg accident, hydrogen has been deemed unsafe. But with the unique design of the Omega, the use of hydrogen will be acceptable.

Plans call for the central inner compartment called the balloonet to be filled with hydrogen while the larger main compartment be filled with helium. The advantage of this system is that the highly flammable hydrogen is insulated from engine heat and other possible sources of detonation by the inert helium in the main compartment.

With 250,000 cubic feet of helium and 29,000 cubic feet of hydrogen, the vehicle will have a net bouyant lift of 15,000 lbs. While the circular platform of the vehicle will not produce an efficient wing; it does allow for a light, simple structure. Low weight and large volume will more than compensate for the structure's aerodynamic deficiencies.

As with most large, extremely slow vehicles, control will be difficult. A standard tail with rudder and elevators will not be adequate for operating amidst mountain peaks. (It would also detract from the flying saucer appearance). Instead, a large canard wing in combination with vectored thrust will be used. By banking the canard, it can act as a rudder to provide lateral control. By changing the canard angle of attack, aircraft altitude can be controlled. Vectored thrust will be used to compliment the canard control system.

The design will also test the feasibility of using movable ballast as a further means of control. The ballast will consist of 5,000 lbs of water treated with anti-freeze to prevent high altitude freezing. A system of piping and pumps will be used to transfer ballast to any of 12 reservoirs located on the perimeter of the craft.

Future plans for the project call for the addition of solar panels. The basic structure is ideal for such an application. The vehicle's large upper surface area will provide more than enough space for solar cells while high operating altitudes insure little cloud cover. Electricity generated by such a system can be used to propel the craft and to produce hydrogen (to replace attrition due to leakage). The addition of solar panels will give the vehicle virtually unlimited range.

jaro, among other places. At Kilimanjaro, of the nine or so people who attempted to fly off the mountain, three had successful flights, traversing 15,000 feet to the ground. For the three who made it, their flights were not without drama. Just off to one side of their flight path after takeoff was a huge boulder that required some skillful manuevering to avoid. The last person to attempt the flight stumbled on his takeoff run, launched anyway,and only at the very last possible instant managed to bank away from the boulder. However, his movements resulted in a series of oscillations that took a half hour to dampen out.

successful flying off Kilimanjaro did make successful flights off other mountains in Kenya and Tanzania, but these journeys had their own moments of drama. Coming in for a landing during one such time, Alan found himself heading to a mass of school children between the ages of twelve and eighteen. It turns out that in this region of Africa, the closest any had come to any sort of flying vehicle was seeing airliners over head at 35,000 feet. Suddenly, from out of nowhere came Alan floating into their midst. The shock was considerable, but short lived, for Alan and his hang glider were lifted up on the kids' shoulders and he was paraded around as some sort of hero. Alan remarked that it was the closest he has come to being a rock star.

A more dramatic occurence took place as the group was travelling between countries to visit various mountain ranges. At the time, Uganda was at war with its neighbors, and to Kenyan border guards, hang gliding enthusiasts toting their crafts compacted into long cylinders looked suspiciously like mercenaries lugging mortars. Fortunately the guards decided to ask questions verbally rather than with machine gun fire.

Hang gliding itself is exciting--Alan calls it the greatest sport in the world--but half the fun is getting there in the

The Surface Contingent

A recent finding at the General Motors Research Laboratories has changed scientific thinking about the behavior of electrons in metal surfaces. This discovery provides a greater understanding of the fundamental physical processes involved in such surface events as adhesion, corrosion and catalysis.

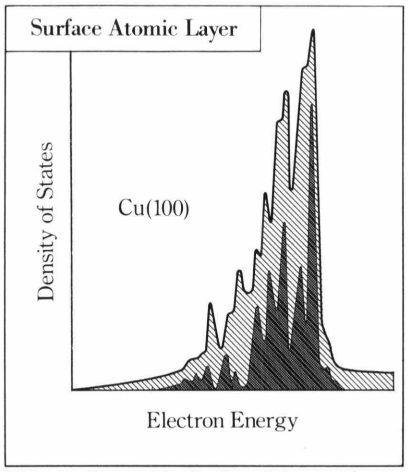
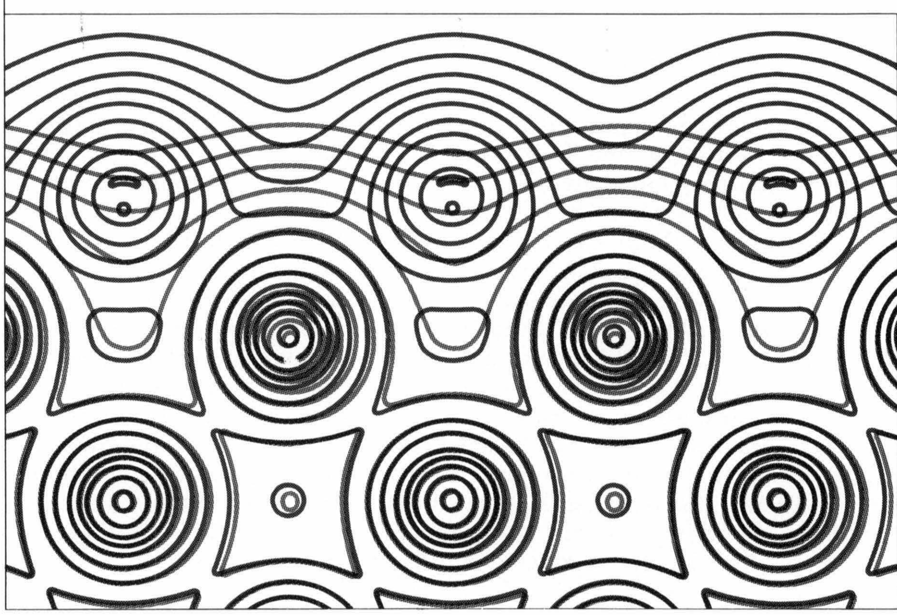


Figure 1: Energy distribution of electrons in outermost atomic layer. Shaded area indicates electrons in surface states.

Figure 2: Two electron density contour maps of the cross-section of a Cu(100) surface. One map shows a clean copper surface (lt. gray); the other shows a nitrogen-covered copper surface (dk. gray).



CONVENTIONAL scientific thought treats virtually all of the valence electrons found in the surface atomic layer of a metal as if they are free to roam throughout the metal's interior. The work of three physicists at the General Motors Research Laboratories suggests otherwise. Through calculations confirmed by experimental data, the theorists have shown that more than a quarter of the valence electrons in the top atomic layer of some metals are effectively trapped in the surface. The presence of so many "surface state" electrons must be considered when analyzing physical and chemical surface phenomena, including such surface events as oxidation leading to corrosion.

Drs. John Smith, Jack Gay and Frank Arlinghaus applied their theoretical analysis to the (100) surface of five metals: copper, nickel, silver, rhodium and palladium. They made bold predictions concerning the percentage of electrons in the surface atomic layer to be found in surface states: Cu(36%), Ni(23%), Ag(23%), Rh(23%) and Pd(19%). The ratio of the shaded area to the hatched area of figure 1 gives the percentage for copper.

Electrons in surface states are not only abundant, but also highly localized on the surface. Chemisorption on a metal is also confined to the surface region. Figure 2 shows what happens in the case of nitrogen chemisorbed on copper. The two contour maps coincide except in the surface layer, where the interaction is largely exhibited. Localization of the interaction holds for the chemisorption of other gases, including oxygen in the initial stage of metal oxidation. These observations led the physicists to conclude that surface states are important in chemisorption.

One way to probe electrons in surfaces is to chemisorb atoms on a clean metal surface and look for changes in photoemission spectra. Such an experiment was performed at GM for fractional monolayers of nitrogen, oxygen and sulfur on Cu(100). The dominant change in the photoemission spectrum was the disappearance of a large peak whose shape and energy location was independent of the chemisorbed atom. It was of special interest that the shape and energy location of this peak was nearly identical to the envelope around the surface state peaks in figure 1. This suggests that surface state electrons play a major role in the chemisorption process.

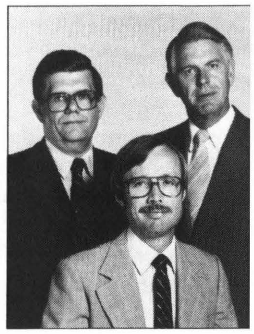
THE THEORETICAL advance at the heart of the discovery is the "Self-Consistent Local Orbital (SCLO) Method" for solving the Schrödinger equation. This new mathematical method was devised by the GM theorists to handle the classic dilemma posed by the self-consistency requirement. The characterization of electron behavior used to complete the equation must be consistent with the behavior predicted by the equation. In other words, one almost needs to know the answer in order to make the calculation.

Self-consistent solution of the equation for a metal surface is made exceedingly difficult by the three-dimensional nature of the electron density distribution. The theorists dealt with this challenge successfully by dividing the electron density distribution into two parts—the first part due to overlapping atomic density distributions; the second part equaling the difference between this atomic contribution and the exact density distribution.

One of the more stringent tests of the accuracy of the SCLO method was an angular photoemission experiment conducted by Heimann et al., at the University of Munich subsequent to publication of the GM research. The German research team confirmed a prominent surface state band predicted by the three GM physicists. This was the first time a surface state band on a solid had been calculated prior to its being seen experimentally. The SCLO method makes possible something that could not be done before—accurate prediction of the actual behavior of electrons whirling around nuclei at the surface of a metal.

"The large body of surface states we found on metal surfaces," says Dr. Smith, "may be a controlling factor in many physical and chemical surface phenomena. By replacing conjecture with calculation, the new surface theoretical methods give us the means to make major steps forward in the analysis of surface and interface properties."

THE MEN BEHIND THE WORK



Drs. Smith, Gay and Arlinghaus are theorists in the Physics Department at the General Motors Research Laboratories.

John Smith (center) and Jack Gay (right) received doctorates in physics; Smith from Ohio State University and Gay from the University of Florida. Frank Arlinghaus received his Ph.D. in physical chemistry from the Massachusetts Institute of Technology.

John Smith, leader of the GM solid state physics group, did postdoctoral work at the University of California in La Jolla. He joined General Motors in 1972. Frank Arlinghaus and Jack Gay joined the corporation in 1964 and 1965, respectively.

Each member of the team brings to the project a different expertise: Smith in surface physics, Gay in solid state theory, and Arlinghaus in bulk band structure calculations.

first place. Thus, after Africa, the group turned its attention to flying off Mt. Everest. One immediate difficulty that arose was how to transport the hang gliders up the mountain. Drawing on their engineering background and in tune with the widening interest in LTA ships and hybrid vehicles, the group thought up the saucer-like Omega. The characteristics of Omega especially suited the purposes of a Himalayan excursion, as high altitude capability is a necessary and long range a desirable feature.

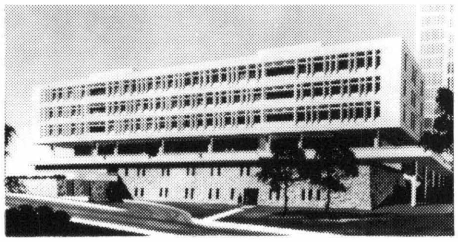
The plans for a Himalayan excursion are far less set than the design specifications of Omega itself, which is hoped to be turned into a research project on its own merits. This has not stopped Alan from speculating about flying to Everest in Omega, and one issue he has been dealing with is how to get from Omega to the mountain side. Despite its STOL nature, there is no place to land. Being a hybrid vehicle where the need for aerodynamic lift precludes hovering; the craft has to be in continuous motion. Alan speaks of firing ropes into the mountain side and sliding down to the surface, apparently while Omega flies a circular pattern over the anchorage point. That should be an adventure in itself.

How serious is the Dynasoar group about the Omega hybrid vehicle? Fairly serious, as preliminary blueprints and design specifications have been drawn up. What has kept Omega from developing further are the usual restraints of time and money. To test out the feasibility of the craft, Alan would like to construct a scaled-down, one man version, and from there work on the full size craft. There are many areas that need further study before construction begins, including studies in stability and materials. The prototype is to be powered by two modified Volkswagen engines, although solar power is being considered for future versions. Range would then be essentially unlimited, depending on the amount of crew supplies that can be loaded.

Alan is hoping to generate enough interest to entice some engineering undergraduates to adopt Omega as a project and flesh out basic design criteria. His own research on work for his doctorate degree prevents Alan from pursuing Omega on his own at the present. The desire for his own flying saucer though remains strong, which is eminently understandable. Given the chance to ride in a flying saucer, who could refuse? ■

Completion of Whittemore Hall

by Paul Atkisson



With the nation needing the science of engineering to maintain productivity, a higher standard of living, as well as national defense, the demand for engineers has never been greater. At Virginia Tech, one of the ten largest schools of engineering in the country, that demand is illustrated at graduation with each senior receiving an average of three employment opportunities during recessionary times and seven offers during prosperous economic times.

The vast opportunities and lucrative job offers have caused an increase in the numbers of qualified students seeking admission which is beneficial to the nation, but at Virginia Tech and most other engineering schools, one problem is the shortage of academic space to conduct teaching and research activities, including critical laboratory instruction. Some students who resided outside of Virginia and who qualified for the honors program were refused admission into Tech's College of Engineering this year because of a lack of space.

These problems have caused many concerns for Engineering Dean Paul E. Torgersen and his faculty who would like to see all qualified students gain admission while maintaining adequate space for instruction and faculty research. With knowledge of the problems facing Tech's engineering college, the Virginia Society of Professional Engineers (VSPE) decided to engage in a state-wide effort of support for the addition of Whittemore Hall during the last session of the Virginia General Assembly. Their efforts culminated in an "eleventh hour" amendment to fund $3.2 million for the completion of Whittemore Hall. Since the actual cost is $7 million, the college will engage in a major fund raising campaign during the 1982-83 academic year in order to secure the remaining funds.

Whittemore could have been completed by funds which were appropriated during the 1968-70 biennium for its construction; however, during that same period, several major projects were in the planning and/or bid process and it was determined that University priorities would allow construction of only the first three floors to house the departments of Electrical Engineering, and Industrial Engineering and Operations Research. The remaining three floors were to be constructed at a later date. Thus, plans for the remaining three floors are now complete and require only revision for present day codes, energy conservation measures, and minor changes in proposed functional uses.

The delay in the construction has caused faculty morale problems. Engineering faculty who were recruited for their outstanding scholarly leadership potential in 1968 and later, and told of Whittemore's pending completion became stymied over the years by the lack of adequate space to conduct their instructional and research activities. This 12-year delay was one reason why during the 1980-81 academic year, an unprecedented number of engineering faculty elected to relocate to the private sector or to other universities where resources were sufficient to support their needs. The college was fortunate to be able to replace 17 of the 23 faculty who left and persuaded an additional three visiting professors to remain.

"It seems as though by comparison to other colleges of engineering we are doing relatively well with faculty recruitment," the dean said.

Nationally, there are about 2,000 vacancies in the nation's 286 schools of engineering.

Virginia Tech, as the Commonwealth's Land Grant institution, "has one of the largest and finest colleges in the country. The College enjoys an excellent national and international reputation, and offers a wide variety of high-quality technical programs," the dean said. "The completion of Whittemore was needed to maintain this reputation. Otherwise, an already acute space problem would have further demoralized the quality of engineering instruction."

In addition, any further delays in reducing space shortage existing in Tech's engineering college could have also placed certain departments in jeopardy with the engineering accreditation board. ■

Becky Abbott—The Dean's GTA

by Cathy Crotty

Of all the teaching assignments offered to graduate teaching assistants in the College of Engineering, one of the most unusual and challenging of the positions was given to Rebecca Abbott last spring. Becky, a graduate teaching assistant in Industrial Engineering and Operations Research, was asked to assist the professor of IEOR 4290, *A Theory of Organization.* The class assignment itself was nothing unusual for a GTA, but the "kicker" was that the class was being taught by Dean Paul Torgersen.

When asked for some candid comments about working for the Dean, Becky said that her job required some unexpected duties. For example, when Dean and Mrs. Torgersen hosted the class at their home for a luncheon, Becky spent the day cutting cakes and arranging cold cuts. But, for the most part, her work was routine. The bulk of her job consisted of weekend test grading marathons, averaging grades and sitting in on classes. As a graduate student, Becky enjoyed attending the class that she completed as an undergraduate. She got a real kick out of hearing Dean Torgersen get laughs for the exact same jokes he used the previous spring and presumably before that. Unfortunately, she was sometimes the brunt of the jokes. Whenever any complaints were made about grades or test questions, the problems were jokingly blamed on Becky.

These administrative duties were nothing new to Becky. She has previously assisted Dr. Marvin Agee in two courses, *Introduction to IEOR* and *Methods Engineering.* Although Becky enjoyed assisting with Methods (and its accompanying lab), she wanted to devote a little more time to her own studies so she looked for an assignment which would not require her teaching a lab. *Theory of Organization* provided her a slightly lighter load.

Her extra study time must have been well spent, for she and her upstairs neighbor at Foxridge, Drew Ring, coauthored a critique of a machine tool economics method. The paper won the Society of Manufacturing Engineers' Alfred E. Bodine award which included a $5,000 prize. Becky was also the recipient of last year's Frank and Lillian Gilbreath Material Handling Institute fellowship for $3,000, and is currently preparing a paper with Dr. Tim Greene for presentation at the 1982 Winter Simulation Conference in San Diego.

Becky's undergraduate career at Tech was outstanding. She was first in academic rank in the IEOR department's 1981 graduating class and was named to Who's Who in American Colleges and Universities. Becky was also one of 30 students selected to go on the Pratt trip, the College of Engineering's all expense paid trip to Europe.

Becky enjoys teaching and ultimately hopes to get a Ph.D. and teach engineering. Currently, Becky is pursuing her master's degree in a manufacturing engineering option under Dr. J.M.A. Tanchoco. Her thesis will discuss the uses of computer graphics software in plant layout. Upon completion of her degree work at Tech, Becky will either continue graduate studies or pursue a Ph.D. degree. ■

How to Make the Most of your Plant Trips

by Lee Shaw

By the time you graduate from Virginia Tech, you will have taken many courses which will help when you start to work. You will have taken courses in computer programming, thermodynamics, fluid mechanics, and electrical theory. You will have even been taught how to write-up your resume and how to make a good impression at job interviews, but you will not have been taught how to make the most of one of the most important parts of your senior year: your plant trips. To correct this deficiency, we have put together this informative guide of factors you should consider when planning and taking your plant trips.

First, let's clear up some common misconceptions about plant trips. Many of you probably think that the reason for you to go on plant trips is so that you can see places where you might work. Nothing could be further from the truth. The real reason is so that you can gain valuable experience making airline reservations, dealing with airport panhandlers, and losing your luggage. Companies realize that you probably haven't had the time or the money to do this while you were in school, so out of the goodness of their hearts, they will treat you to the opportunity to do it during your senior year. Another common myth is that the reason for you to interview with companies through the placement office is to get a job. Nonsense! If you want to get a job, all you have to do is pick up the want ads--there are plenty of jobs there. Just ask President Reagan. No, the real reason to interview is so that you can go on plant trips, and the reason to go on plant trips is so that you can gain valuable experience making airline reservations, dealing--OK, OK! I know you've heard all this before, I just wanted to see if you were paying attention. Now that I've debunked these myths, let's get on with the plant trip guide.

PART I: SELECTING PLANT TRIPS

When selecting where you will go on your plant trips, you may wish to use one of the following strategies:

Joe Jet-Setter--Try to pack as many trips into the year as possible. Don't let classes or other activities bother you--professors are always nice to graduating seniors, and someone else will always be there to pick up the slack in other groups you're in. The best way to do this is to plan trips to the same area around the weekend. So you'll miss a lot of parties. Who cares about seeing your friends when you can spend the weekend in Cleveland?

Terri Tourist--Use your plant trips to take vacations that you could never afford. Go to Florida in February to get that pre-spring break tan. Go to New Orleans for Mardi Gras. Go to Colorado for a ski vacation. Go to Munich for Oktoberfest (If you find a company that will pay for this, write to me in care of *The Engineers' Forum*). Go to New York City to catch a Broadway show. Go to New Hampshire to catch pneumonia. Go to Hawaii anytime. Places you will probably want to avoid: Pittsburgh, Buffalo, Morgan City, Los Angeles (during mud season), Panama Canal, Love Canal, anywhere in New Jersey, any state beginning with "North."

Sam Show-off--Use your plant trips to visit friends and relatives. This is particularly satisfying if they thought that you would never amount to anything. If your visit does not impress them, remind them that whenever they go on vacation, they have to pay for it, whereas you can go for free. If this doesn't impress them either, forget them. They are idiots.

Donna Dartboard--This is good if you have no imagination whatsoever. Just put a map of the United States on your dartboard and throw darts. Take your plant trips to the places the darts land. Although using this strategy exhibits a dearth of imagination, it is preferable to the next strategy.

Eddie Employment--As hard as it is to believe, some people actually go on plant trips to get jobs. (I hope that none of you are this unimaginative, but my sense of journalistic responsibility requires me to present this strategy just the same). They plan their trips to companies they are interested in and to parts of the country they might like to live. Following their trips, they decide on a job, get married, move to the suburbs, have 2.4 children and live happily ever after.

If none of these strategies suits you, come up with your own, or call me and I'll tell you where to go.

PART: II GETTING PLANT TRIPS (On Campus Interviews)

Once you decide where you want to go, you must convince (emphasis on "con") a company to send you there. Here are some tips that will help you impress interviewers:

Make an unforgettable impression--Try to make yourself stand out from the pack of three piece suits, blazers and skirts. Use your imagination, but don't exceed the bounds of good taste. Wear a Nehru jacket and rose-colored glasses. (This will also impress the interviewer with the maturity of your outlook.)

Impress the interviewer with the breadth of your knowledge--Recruiters like to know that the engineers they hire are not just narrow specialists. (You know, your stereotype cement head, circuit head, motor head, etc.) Here's a good way for you to show that you are a well-rounded individual: When you walk into the interview room, greet the interviewer in a foreign language. (Avoid the more familiar languages, like French, German or Spanish--Go for something like Swahili, Arabic, or Korean.) When he says "Wha-at?" act surprised, and say "Oh! You speak English?"

Be on your best behavior in the interview--Leave your whoopee cushion and joy buzzer at home. (Groucho Marx nose and glasses are okay though--see "Make an unforgettable impression".) Under no circumstances ask the interviewer how many polyesters had to die to make his suit or whether the palm tree scene painted on his tie glows in the dark.

Always remember why you are there--Your main goal in the interview is to get a plant trip offer, so act interested in anything the interviewer says. Keep asking questions, because if you don't, he will ask you to tell him about yourself. This the last thing you want to happen, because the less he knows about you, the better your chances of being offered a plant trip.

Stay Cool--No matter what happens, remain calm. Don't make threats upon the lives of the interviewer's family that you can't back up.

Play practical jokes on people waiting to be called in for their interview.--Actually, this has nothing to do with getting a plant trip, but it is a lot of fun. Here's how. If you see someone you know waiting for an interview, walk down the corridor so you can't be seen and call his (or her) name in an authoritative voice. Watch him or her jump up and try to look intelligent while everyone else in the waiting room stares.

PART III: PLANT TRIPS

Once you've been offered a plant trip, the hard part is over--all you have to do now is enjoy yourself. Here's a semi-chronological list of what to do on the trip:

Airports--Most likely, you will be flying out of Roanoke International. About the only exciting thing to do while you wait for your flight (don't kid yourself--you will wait. Piedmont leaves on time about as frequently as you finish thermo tests early) is have your shoes shined, and even this gets old after eight or nine times. About the only advantage to flying out of Roanoke is that there are never any religious cult members trying to convert you to The Church of the Eternal Exit Sign. You will meet people like this at most other airports, and unless you can run like O. J. Simpson or you haven't had a bath in 2-5 months, you will have to deal with them. The best way to minimize your contact with them is to remember Woody Hayes's rule: If you can't be defensive be offensive (or something like that.) Carry some brochures from tourist attractions (Luray Caverns, Natural Bridge, Chairman Mao's Celebrity Wax Museum, etc.), and when you see a dude with a shaved head and flowers head your way, hand him one before he starts his spiel. This should momentarily confuse him so that you can get away.

Luggage--Carry-on your luggage if possible. This minimizes the chances that you will be stranded in New Orleans with only your Led Zeppelin 1977 Tour T-shirt, a pair of worn out Levi's, and your Nikes. Also, your stuff is probably safer with you than with simian luggage handlers.

Flight Insurance--Don't bother with insurance for yourself--it's not going to do you any good. Use your money on other people. Whenever one of your friends goes on a trip, send 25¢ ($2.00 if he's never flown before) with him or her to use on an insurance policy naming you as beneficiary. You'll be surprised how appreciative they'll be of your thoughtfulness.

The Flight--Airplane flights are really nothing to worry about, but if the pilot introduces himself as Captain Over or if there is a nun on board with a guitar, head for the nearest exit, even if the plane is already in the air. It's better to learn how to parachute on the spot than to be caught in a bad movie. It's alright to drink the beverages on airplanes, but don't eat the food unless you have an iron stomach. Under no circumstances should you ever eat anything called "Smokehouse Almonds." Amuse yourself by talking to one of the stewardesses. Ask her what happens if you're in the lavatory when lightning strikes the plane. Ask her if you'll be able to see the Grand Canyon on this flight. Pretend you don't understand how the flotation devices work and ask her to demonstrate them.

Rental Cars--Your company may provide you with a rental car so that you can get around easily. If this is the case, you can forget about speeding around in one of those shiny, new cars the rental agencies have in their TV commercials. Since you are not one of their priority customers (like O. J. Simpson), and since you won't even be paying for your car, the agency will give you the "student special." This is a car that looks deceptively nice from the outside, but couldn't beat a steamroller in a drag race.

Taxicabs--Those of you who aren't lucky enough to have a rental car at your disposal will have to use taxicabs to get around. Never, repeat never, ask your cab driver what the most exciting thing that ever happened to him was. Also, watch out for cab drivers who try to run up the meter. Examples of things that tip you off to this are passing the same wino passed out in the alley five times, and riding for two hours when you are going from the Airport to the Airport Plaza Hotel.

Seeing the Sights--Since the most important reason for the trip is to travel, this is the most crucial part of the trip. Try to see the major sections of the city. To save time, you might want to visit popular sights at non-peak hours. For instance, if you are in Dallas and want to see the area where President Kennedy was assassinated, go between midnight and six AM, when the crowds are a minimum. (Note: This won't work everywhere--for inexplicable reasons, someplaces, like Disneyland, are not open in the middle of the night.) For your own safety (muggings are not included on your expense sheet), be inconspicuous and avoid attracting attention to yourself--Dress and act just like everyone else. If you're in Texas, wear a cowboy hat. If you're in Atlanta, walk down the street saying, "How 'bout them Dawgs?" If you're in Los Angeles, wear a gas mask.

Conversing with the Natives--Generally, this should not be a problem, since most of your trips will be

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within the United States. Should you find yourself in a foreign country, like Texas or Boston (Bahston), just remember the first rule of linguistics: If you speak slowly enough and loudly enough, you will be understood.

Eating Out--Choosing restaurants in a strange city can be difficult. Of course, you can always fall back on the old stand-bys, like McDonald's, etc., but if you want to be a little more adventurous, here are some pointers:

1. Avoid any place with "EATS" in its name.
2. Avoid places advertising "home-cooked meals." If you wanted home-cooked meals, you should have stayed at home.
3. Avoid restaurants associated with motels that rent rooms by the hour.

Hotels--All of you have stayed at hotels or motels before, so nothing really has to be said here, except that they are good places to pick up cheap (read free) gifts for your roommates, girlfriends, or boyfriends, like soap, stationary, matchbooks, and toilet paper.

The Plant Visit--Basically, you have to remember the same types of things during your visit that you did during your interview (See Part II-Getting Plant Trips), although on a larger scale. Remember: everyone in the building, from the superintendent down to the janitorial staff, knows that you're there to try to hustle yourself a job, so behave accordingly. Don't ask your host who the funny-looking people in the picture on his desk are. Pretend that the coffee doesn't taste like mud.

Some other tips: Whenever you are given the opportunity to go to the restroom, take it. It is better to be thought to have a bladder problem than to listen to eight hours of non-stop propaganda. (Of course, you probably learned this trick when you applied to Tech and came to Summer Orientation) Pump your hosts for information—this keeps them from asking you questions, and as before, the less they know about you, the better. If you visit a place where you will need a security clearance, (you'll know because you have to sign in and out of every room you see), ask your host if you need a security clearance to see the "Cone of Silence" in operation. (If he denies that they have a "Cone of Silence", the answer is "yes.")

Expense Sheet--At some point during your trip, you will be asked to complete a sheet summarizing your expenses. Most of you are probably wondering how much you can get away with. The answer is nothing. From the moment you entered the terminal building at Roanoke Airport, you have been watched, and your expenditures have been observed, so there is no way you are going to get one more dime than you are entitled to. I know that some of you don't believe this and will try to pad you expense sheet. To you, I say "Caveat Sucker."

When you get home--Following your trip, your friends will ask you if you had a good time. Even if you had a lousy time, you must tell them that you enjoyed every minute of the trip. It is an Honor Code Violation to deny that you had a great time on a plant trip, and violators are severely punished. (Some past punishments have included serving as an SGA senator, serving on the staff of the *Engineers' Forum*, working a summer in New Jersey, and helping with the engineering summer camp.)

If you follow all my suggestions, you should really enjoy your senior year, and even if you don't, you can't tell anyone. ■

Dr. Goff continued

Everyone contributes to the project in his for her own manner; the primary goal is to make as many people aware of the issue as possible. Dr. Goff says, "What I do within (the program) is enroll people in the Hunger Project; I run in events to raise money for it and other hunger-related organizations." Action will follow once enough people are confronted with the issue. Dr. Goff is convinced the Hunger Project's goal is a realistic and achievable aim. What it takes is for people to see that the end of hunger and starvation is "an idea whose time has come," the motto of the Hunger Project.

Dr. Goff's interests outside of teaching include theater and photography. Currently he has combined these two interests into one, so that most of his photography involves the theater. However, he has also acted in plays here at Tech, and admits that on a least one occasion, his depth of involvement caused consternation in the AOE department while he was an instructor there.

Recently Dr. Goff's life has become even busier than normal. This past May, his wife gave birth to the couple's first child, Larken. This happy event was followed by the announcement that Dr. Goff had won the Sporn Award. His reaction? "I was thrilled" he said, and relieved after he found out *why* Dean Torgersen wanted to speak with him alone in the Dean's office. The official notice of the award was on May 28 with a reception in President Lavery's office. Because of the award, Dr. Goff spent a lot of time on stage at graduation in June, where incidentally he received his doctorate diploma in Aerospace Engineering.

The connection between engineering and people underlies Dr. Goff's approach to teaching. Not only do non-engineers appreciate his methods, so do engineers. Winning the Sporn Award is not a bad way to end one's first year as an assistant professor. ■

Chris Kraft continued

accused us of overruns and not being able to keep our schedules. The primary problems were financial and we did get into a lot of technical problems, one reason being we didn't have the money to solve them."

As if the unknowns of manned space exploration were not enough, Kraft had to deal with unexpected duties, those of press relations and public scrutiny.

The result was "we recognized we were in dire straits by the time the 1977-78 budget was prepared." It was at this point that the Strategic Arms Limitation Talks (SALT) were being negotiated, and the Department of Defense recognized the importance of the space shuttle as an observation facility to carry out the premise of the SALT agreements. The Carter administration said to NASA officials, 'My God, you can't let this schedule slip any further. We need that machine. How much money do you need to do it?' Kraft recalls.

"We had been telling the Congress that we didn't need any more money for two or three years prior to the DOD support because the Office of Management and Budget (OMB) would not allow us to ask for additional appropriations. As NASA administrators we were forced to tell Congress that we didn't want additional help because the administration was telling us we couldn't have any. We were defending a budget that we knew would not work. When the DOD lended their support and Congress asked us what additional money was needed to get the shuttle in motion, we then had to tell them $600 million over the next three years.

DOD support sounded great, and it was as if all we had to do was stand there and give up the pound of flesh and the pint of blood it took for us to achieve this victory. But this was when the press strongly criticized us for our tremendous overruns, calling it a big surprise. We did not have overruns. We were very proud of our financial management. People forgot about inflation and the fact that we would be promised a billion and a half dollar budget a year and never receive more than a billion," the director says.

Kraft agrees that the space program does have tremendous defense potential, but there will have to be some "leapfrogging approaches" made in order to checkmate the nation's enemies. "I do not believe one can ignore the defense of offensive aspects of technology. We are providing tools for commercial, scientific and industrial development of space, but the defense measures are also present."

The Russians "despise" the space shuttle because they recognize the great potential it has in preventing them from conquering the world. "It has furnished the keystones of advancement for technology in space during the next twenty to thirty years, so its investment was not that great when you consider it against the total U.S. investment in research and development.

"Scientists are like the goose and the golden egg. If we didn't have the space program you wouldn't have a goose to lay any eggs. And all of the eggs that are getting laid are golden and give the scientists a tremendous capacity to do things . . . We, the engineering community, have furnished scientists with a capability to carry out science and research and make new discoveries that they would never have had the potential or capability to achieve without the space program."

As one of the founding fathers of the nation's space program, Kraft retired this past August. In a humorous sense, he grins and says his retirement makes him feel "old and tired," but in a serious note, he adds, "The life I have led as an engineer or pseudoscientist has probably been as great as it could have been. The challenge has been fantastic, and I am sorry about leaving it, but a man doesn't last forever . . . I had hoped that one day I would have flown on a space shuttle, and I still have those hopes." ■

Editor's Note-This story was prepared for the Virginia Tech Magazine.

Short Takes

Engineering returns to **Patton Hall.** To help ease the engineering space shortage, the Civil Engineering Department is moving from Norris to Patton, and Engineering Science and Mechanics is to move into the spaces vacated by CE. Over the summer CE started moving into Patton's first floor offices. Stage II of the process, to be completed by the end of fall quarter 1982, will see the Student Housing office relocated to Eggleston Hall and CE's administrative offices moved into Patton's second floor office spaces. Stage III should see the Placement Services moved from Patton to Henderson Hall. Patton's third floor will be renovated for Arts and Sciences, and the Departments of Geography and Philosophy and Religion will move from Henderson to Patton's third floor. Target date for these moves is June, 1983. The final stage will relocate counseling to Henderson, and CE will complete its occupancy of Patton's second floor by the start of fall quarter, 1983. The entire move is being coordinated by Dr. Richard Walker, department head of CE, and the department head of ESM, Dr. Dan Frederick.

To stimulate interest in advanced courses in math and science among Virginia's high school students, Virginia Tech is promoting the formation of **JETS** (Junior Engineering Training in Schools) clubs. Virginia will be joining the 25 year old national organization which boasts nearly 7,000 members.

The JETS clubs expose high school students to engineering applications of math and science. JETS will provide monthly newsletters, engineering aptitude testing, and design contests. Field trips and expositions are organized on the local level. The program is being launched this fall with a goal of ten chapters in the state by the end of the 82-83 academic year.

State coordinator, Pamela Kurstedt of the College of Engineering, has already contacted high school teachers in the Commonwealth and hopes to involve other engineering colleges in the program.

Professor Ali H. Nayfeh, a professor of Engineering Science and Mechanics, received a $40,000 prize from the Kuwait Foundation for the Advancement of Science. He was selected for the prize because of his work in developing perturbation techniques.

Perturbation is a technique for determining approximate solutions for differential algebraic equations.

Nayfeh is the author of three books on perturbation, one of which has been translated into Russian. The professor was nominated for the prize by Yarmouk University in Jordan, where he is on leave from Virginia Tech.

Nayfeh, who received his degrees from Stanford University, has been helping Yarmouk University since 1980 in establishing a college of engineering.

Nayfeh said the Kuwait Foundation prizes were established to promote science in the Arab world and must be given to someone of Arab ancestry.

It seems that Stanford University wants **David Parekh**. After being notified of his acceptance for graduate study in Mechanical Engineering, David received a phone call from a Stanford professor. After offering David a fellowship, $8,200 for tuition plus $625/month for living expenses, the professor inquired as to whether or not David was interested in other schools. On hearing that David also applied to MIT, an additional $300 was offered to offset the difference in moving expenses. Just in case David still wasn't sold, a trip to see Stanford, sort of an academic plant trip, was also offered.

Sounds like a lot of trouble to get a single student, but not when you consider that David graduated top of his class in Mechanical Engineering with an almost perfect 3.945. David was also president of the Campus Crusade for Christ, heavily involved in the Student Engineers' Council, and a member of Tau Beta Pi. Needless to say, David will be attending Stanford this fall. Says David, "It is a gift from God."

A change in the **honors program** for engineering students may allow a student to obtain a master's degree in less than five years. The new program, affecting freshmen and sophomores, reflects the vast increases in the academic abilities of the students choosing Virginia Tech's engineering curriculum.

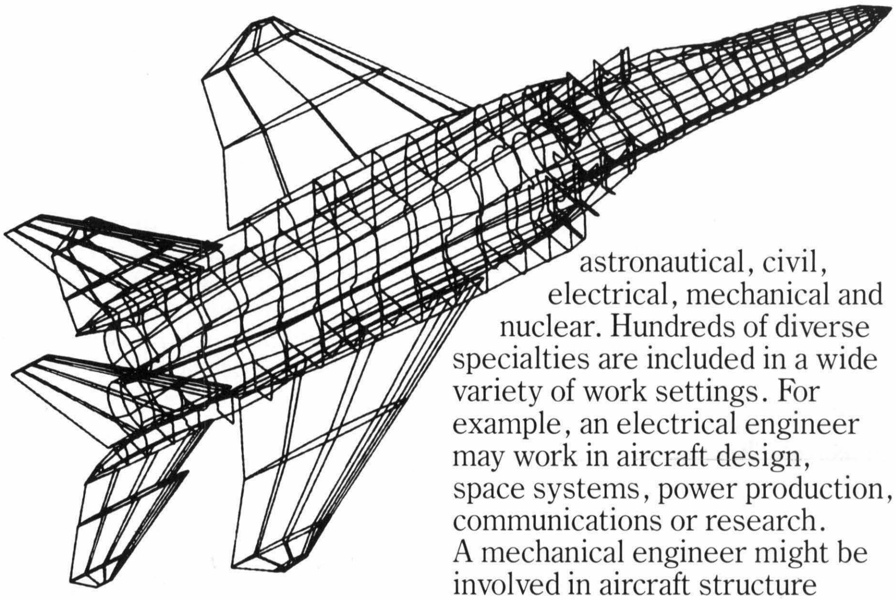
In 1976, only 39 percent of the freshman class ranked in the top ten percent of their high school class. By 1981, that percentage increased to 67 percent. This forced the engineering faculty to teach more challenging classes throughout the college curriculum, not just in the honors classes. This resulted in low attendance in the honors program.

During the past few years, students also discovered that the distinction of being an honors graduate has had little meaning to employers or other students, said Pamela Kurstedt, director of the college's enrichment programs. "And the students with advanced placement found it difficult to complete the honors program requirements. These students already had credit for many of their core courses, which would not allow them to enroll in the honors sections for these courses," Kurstedt said.

Juniors and seniors already in the honors program should work with Kurstedt in order to provide for a smooth transition.

After a search which took more than eight years, **Triangle Fraternity,** the fraternity of engineers, architects and scientists has finally found a house. Located just outside of the Blacksburg municipal limits, the house sits on a hill overlooking South Main Street, not far from Gables Shopping Center. The house has 7400 square feet, and when completed, will house 25 brothers. To save money, the brothers have been doing most of the construction work themselves.

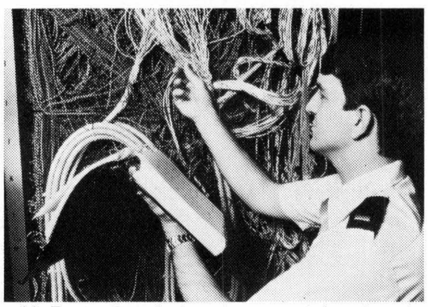
ENGINEERING TAKES ON EXCITING NEW DIMENSIONS IN THE AIR FORCE.



Computer-generated design for investigating structural strengths and weaknesses.

Developing and managing Air Force engineering projects could be the most important, exciting challenge of your life. The projects extend to virtually every engineering frontier.

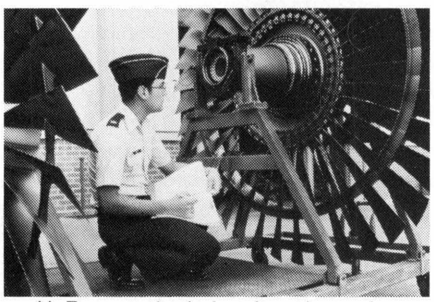
8 CAREER FIELDS FOR ENGINEERS



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.

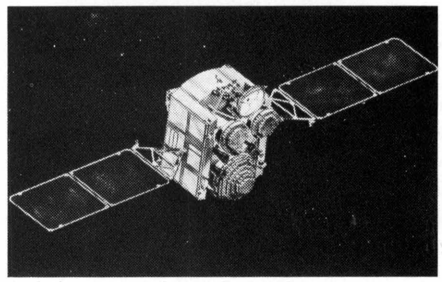
PROJECT RESPONSIBILITY COMES EARLY IN THE AIR FORCE



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.)

Recently, the Air Force formed a new Space Command. Its role is to pull together space operations and research and development efforts, focusing on the unique technological needs of space systems. This can be your opportunity to join the team that develops superior space systems as the Air Force moves into the twenty-first century.

To learn more about how you can be part of the team, see your Air Force recruiter or call our Engineer Hotline toll free 1-800-531-5826 (in Texas call 1-800-292-5366). There's no obligation.

AIM HIGH
AIR FORCE

From Virginia Tech to America with Love

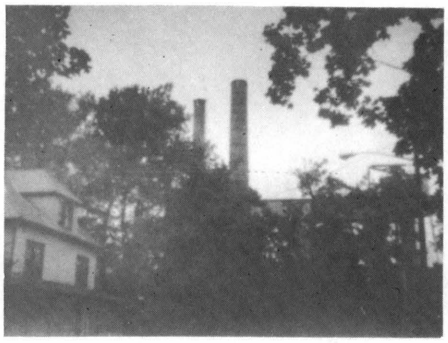
by Chris Coleman

The old and credible standard which separates engineers from scientists can be summed up in one word, "applications." If you haven't heard it yet, scientists generally work to understand the mechanisms of nature, while engineers 'apply' this knowledge for the benefit of mankind (or themselves, their employers, their country their wallets, etc...) It is a multiple choice question. For this reason, and this reason alone, it is obvious that an engineer should receive some minimum of broadening education to help him make decisions that are part of his job. Add to these decisions the extreme power over life, death, and environment which are inherent in the application of many engineering technologies. Now not only can a need be seen for broadened education, but also an active role in the policy-making process of scientific applications.

"That first paragraph sounds great," says my friend the engineering student. "Perhaps you should pursue a career in politics, but what does it have to do with passing freshman chemistry or second quarter fields, or finding an open computer terminal, or the incidence of cancer in New Jersey?" Well, it has little to do with the challenge of mastering a technical field. The development of civic consciousness in the individual engineer is a responsibility in addition to the requirement of technical proficiency. Yet, while the engineering establishment goes ahead full speed in the pursuit of increased technical proficiency, very little consideration is given to helping the rising engineer gain wisdom and influence in the realm of policy-making.

In fact, any indepth venture in this realm of socio-technical studies may be discouraged by the present system. Because a sound technical education often seems to be based on the quantity of work, most engineering students can see that it benefits them to spend most of their time studying technical material to the exclusion of social studies. Later, when an engineer finds work in industry, he is again under pressure to produce more technical results with little or no regard for the social implications of his work. In other words, all of the political and social opportunities in America are open to engineers, but few have time to pursue them adequately.

Likewise, the policy of the College of Engineering at Virginia Tech sounds great. Your 30 hour humanities electives should provide: "1) An understanding of the principal changes taking place in the contemporary world, considered as an interacting whole, but with attention to the role of technology in human life. 2) A perspective on the human condition and on human values and problems as they are embodied in history, philosophy, literature, and the other arts. 3) . . . . It goes on to include an understanding of social science, and ability to continue humanistic education, the skill to work with specialists in other fields, and "an increase in critical judgment, flexibility, creativity, tolerance and sensitivity to the response of others to ethical and



"Last summer a government study reported the incidence of cancer in New Jersey to be 44% above national average."

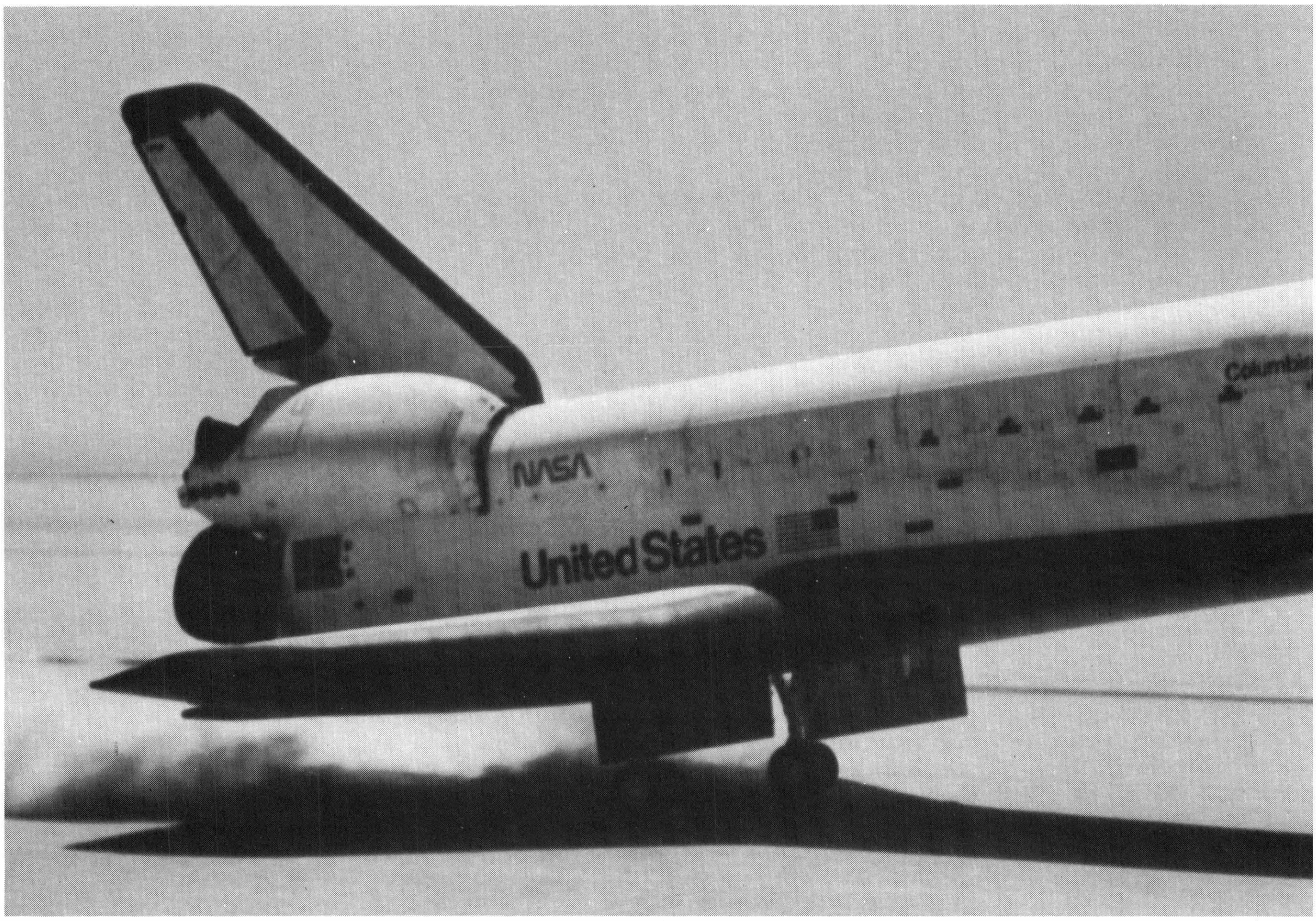
aesthetic values." That is quite a tall order to be filled by freshman English, art appreciation, and the history of science. The mechanical Engineering Department alone offers a high level technical elective entitled "Complexity of Social-Technical Problems." However, most engineering students use their technical electives to gain additional training. An engineering student at Virginai Tech can all to easily string together a disjointed series of humanities electives which give him little insight into "the role of technology in human life."

This need for a more "humanistic technology" was expressed also by Admiral Rickover when he visited our campus last spring. Unfortunately, he failed to give any insight into a realistic approach for its development. He may have failed to realize that in addressing university students and faculty, he was confronting some of the most perceptive minds in the entire engineering establishment. Any well conceived drive for a more humanistic technology must begin in the nation's universities. Universities are shielded both from a vested interest in the status quo and the overpowering pressure to produce profits. They are institutions of higher learning.

The real beauty of a good humanities education is that it costs little in hard money. It mainly takes a commitment of time and intellectual capacity. Currently, that commitment must come from the student. Concerned Tech engineering students must search out the humanities electives which can help them understand the place of technology in the world today. For the most part, engineering course advisors are ill prepared to deal with their students' philosophical needs, and hence those needs are relegated to nonexistence. The student comes away with the impression that non-technical thought is not important in engineering. He moves on into his career and the belief is perpetuated. It takes a strong commitment to break the cycle. *Recent American History, American Thought, Contemporary Democracy, Macroeconomic Theory,* and *Social and Political Philosophy* are among the many valuable electives which can and should be studied by the engineering mind. All it takes is time, lots of time.

Until such time as money becomes available for improved equipment and smaller classes, the inefficiency of the technical education will not allow sufficient time for the average engineering student to pursue a broad human experience without some extra effort. But if our generation can spend that extra effort now, perhaps our sons and daughters will be born into a more peaceful, passionate, and dynamic world. As the power of our technology grows and the proportion of people on earth who understand it dwindles, it is imperative that engineers begin exersising more thoroughly their duty to mankind. If a broader human responsibility can be instilled in America's engineering students, it will be carried throughout the profession and may prove to be a significant steadying force in troubled times.

Rockwell International know-how is creating new career opportunities ... every day.



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Expand the mind of the microchip.

Remember when electronic calculators were considered a luxury? Well, consider this sign seen recently outside a gasoline station in Schenectady, New York: "Free calculator with an oil change."

That's just one sign of the enormous impact microchips have had on the way we do everything – from banking to game-playing.

But how will we use microchips that are smarter, faster, more reliable, and less expensive to design? How will these new microchips be used to improve systems, products, and processes? As one GE engineer puts it, "The sky's the limit!"

That sky is replete with a number of integrated circuit concepts that GE is applying right now.

There's the custom IC, a chip that performs highly specialized functions. Traditionally, creating this chip has been an expensive, time-consuming job. So we're working on ways to cut design time and cost.

We're using computer-aided design (CAD) to design and simulate chips right on computer screens. We're also developing gate arrays, a system that allows you to build inexpensive prototype chips that can be "played" in systems before the final design is fixed.

Another area that GE is developing is VLSI (Very Large Scale Integrated) circuits. These ICs will eventually squeeze one million transistors onto a single chip.

Where will all this super electronic power be applied? GE engineering manager Don Paterson sees it this way:

"At GE you can innovate from the system down to the chip to create. . .whatever ignites your imagination."

In other words, you can dream it. . .and do it.

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