SPECIAL SUMMER ISSUE

ENGINEERS' FORUM

SUMMER • 1995

BALANCE IS THE KEY

Deadlines and classes didn't seem quite so important looking out across a fantastic landscape which has been there since the dawn of human civilization.

Engineering is an exciting field, constantly evolving and expanding. However, due to its constant state of flux, engineering is also very demanding upon those who seek to learn its laws, rules, and formulae. It takes a fine balance of intense studying combined carefully with personal time to make it through an undergraduate program in engineering.

Classes are demanding, and rightly so. Being and engineer is no different than being a doctor: both must know their professions and execute their skills accordingly or the consequences may be dire.

This issue of the *Engineers' Forum* is aimed at helping freshmen engineering students get a head start (see "The Engineer's Way" on page 2). The college years are said to be the best years of a person's life. Though there will be courses which seem to demand every waking moment (and even some non-waking moments), some time must be spent enjoying, exploring, and expanding your horizons.

While putting this issue of the *Engineers' Forum* together, I took a few hours off and hiked to Dragon's Tooth along the Appalachian Trail (see "Tech's Great Outdoors" on page 6). Having just finished a stressful battery of final exams, and still facing a few deadlines, I threw the conventional wisdom of getting priorities done to the wind and went out and climbed to the top of a mountain.

As I started my ascent of this mountain, I walked along trails, thinking of how I could possibly get all of my responsibilities done. A little voice in the back of my head chastised me for taking the precious hours out of my day to go out on a hike.

A little over an hour later, I crested the summit and perched myself on the outcropping of rocks that is Dragon's Tooth. Looking out across the valleys of southwestern Virginia somehow put everything in perspective for me. Deadlines and classes didn't seem quite so important looking out across a fantastic landscape which had been there since the dawn of human civilization.

The college experience is full of interesting, captivating events, both in and out of the classroom. Be sure to investigate and explore your interests. Tech is a huge place, with something for everyone. The crucial thing is: you have to be your own self-motivator. Your goals, whether they be good grades or great activities, or, preferably, some combination of both, won't come to you. You have to go out and find them on your own.

Ray Easterling

Ray Easterling
Editor-In-Chief

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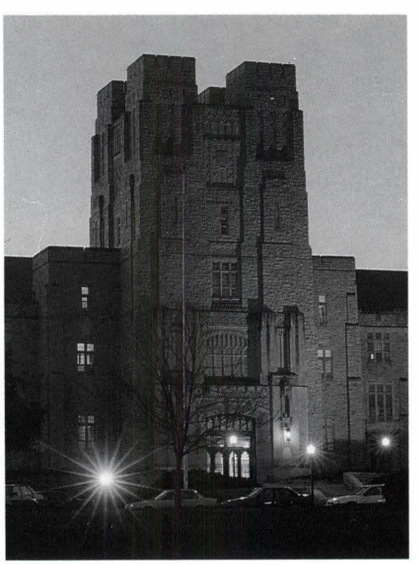

On the Cover

Burruss Hall at night: Housing Tech's administrative offices, this building also serves as stage for visiting speakers, singers, and actors. Photo by James Gibney

The Engineer's Way

By Michelle Romanoski

Entering freshmen to any institution of higher learning are always full of questions. After serving a year at Virginia Tech, some of the answers are obvious, while others take longer to discover. In an attempt to aid incoming General Engineering majors, here is a list of the top ten questions for freshmen engineering students and their answers.

10. What do engineers do, and do I want to do that?

There are several types of engineers. The specific activities that each engineer does depends upon their specialty and their job. Being specified as a GE major (General Engineering) in the freshman year allows students to investigate the different departments to determine where their interests lie. Depending upon the student, an initial interest in engineering may or may not be effected by participation in Engineering Fundamentals. The Engineering Fundamentals program required in the first year allows students to explore all of the options available on campus. If a student decides, after struggling through a semester of FORTRAN, that he or she doesn't want to be an engineer, the construction of the recommended schedule also makes significant changes in major possible. All non-engineering classes required during the freshman year in GE actually fulfill core requirements which are in effect for the entire university.

9. What is the difference between ME, EE, CE, ChE, ISE, BSE, MSE, CPE, and AOE?

This question is one of the principal reasons for the Engineering Fundamentals department. If an entering student does not know the difference between ME (Mechanical Engineering) and BSE (Biological Systems Engineering), how can he or she be expected to choose the specific engineering major that will suit him or her? The other abbreviations stand for Electrical Engineering (EE), Civil Engineering (CE), Chemical Engineering (ChE), Industrial and Systems Engineering (ISE), Materials Science Engineering (MSE), Computer Engineering (CPE), and Aerospace and Ocean Engineering (AOE).

8. Am I supposed to figure out everything by myself?

No. All professors have office hours. These hours are scheduled specifically to answer questions. These questions can range from information on homework, help on concepts discussed in class, to advice on course selection for the next semester and advice about future instructors. In most cases, a student's first semester Engineering Fundamentals teacher will also be his or her course advisor. A course advisor can be helpful, especially when major problems arise. Don't forget about upperclassmen. They have been through the freshman curriculum, and most are sympathetic to the freshman's plight . Here are a few tips from last year's GEs:

"Get to know your professor."
- Joe Mix

"Make sure you know the people in your class so you can get help from them."
- Brian Parisi

"Stay calm, don't get stressed. Work in groups." - Laura D'Angella

7. What are the things in my engineering kit and when am I going to use them anyway?

The package sold in each of the bookstores typically includes two triangles, three scales (those ruler-type things), three mechanical pencils, a protractor, a circle template, a compass, a curve, an eraser, and lead for the pencils. Not included, but required, is a divider. Here is the big secret about the engineering kit: you will not need it until the spring semester.

The only things needed from the kit for EF 1005 are the pencils and the eraser. The other plastic forms will be used in EF 1006 which deals almost entirely with Engineering Graphics.

It is still recommended to buy the kit now, because, typically, the kits are only sold by the university in the beginning of the fall semester.

6. What am I going to do with this computer?

During move-in sometime in August, the computers will be delivered to the dorms. The computer will become part of your life, so it is recommended that it be placed in a useful location where it will be easy to use. The software required for entering engineering students will be the

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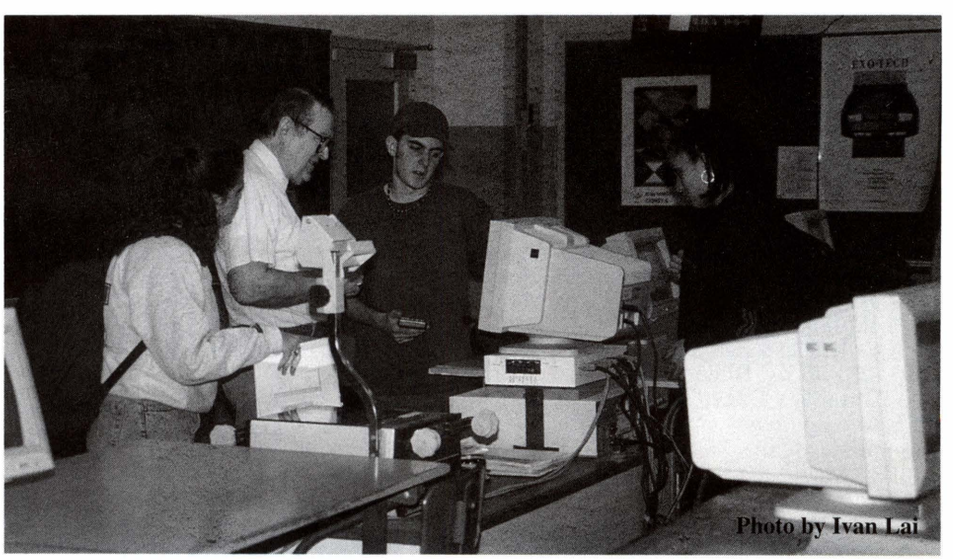
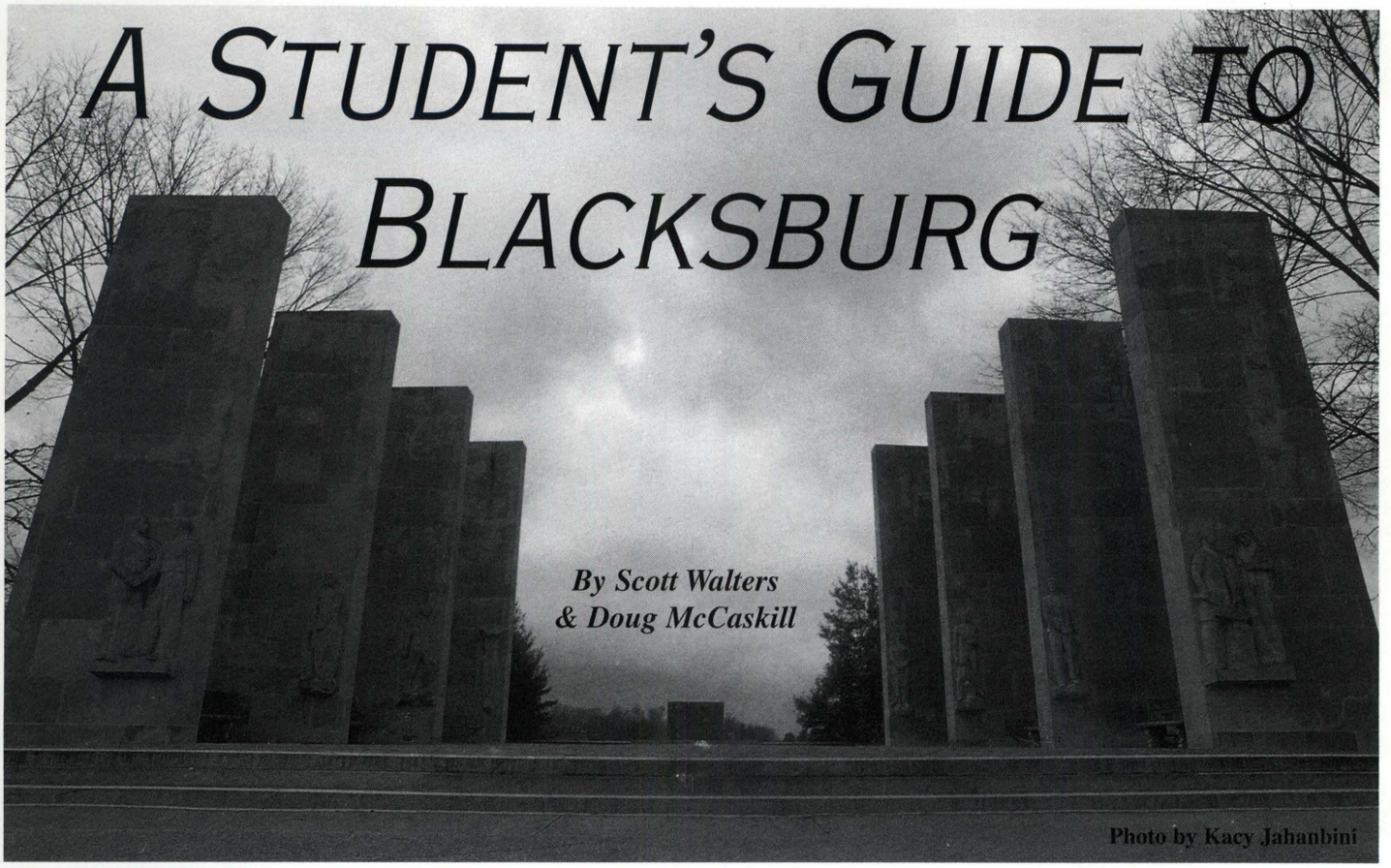


These freshmen engineering students ask their professor about an assignment following class. Good communications can be key to getting desired grades in engineering.

A Student's Guide to Blacksburg



By Scott Walters & Doug McCaskill

Photo by Kacy Jahanbini

The activities to be found in Blacksburg at any given time depend only on a person's imagination and tenacity. Whether you prefer packing into a crowd to see a band or hiking along the Appalachian Trail, Blacksburg and the surrounding area offer plenty of distractions from studies. As a college town, Blacksburg offers the relaxed atmosphere of a small town while providing all the variety of a big city.

On campus, Squires Student Center offers a number of activities in their recreation area. Bowling, billiards, pinball, videogames, and ping-pong all can he had at Squires. One word of advice: the pool tables are very popular and fill up fast. Do not go there and expect to automatically get a table on a weekend night. Instead, go prior to the time you wish to play and place your name on a waiting list for a table.

The Virginia Tech Student Union shows movies every weekend on Friday's and Saturday's in Squires' Haymarket Theater. For two bucks you can see fairly recent movies. Additionally, classic movies are played at midnight. This is best deal going, especially seeing how most movies shown have only been out in the theaters for two or three months. If you must see the latest flicks, then the closest theater is RC Theater at the New River Valley Mall in Christiansburg. They charge standard theater fares for current movies. If money is tight, try the Capri Theater near University Mall. For a dollar and fifty cents, you can see movies a few months after their debut.

For a lazy, relaxed night in, Blacksburg has four video rental locations. Blockbuster Video across from University Mall has a huge selection. The only problem for the discerning shopper is you have to rent the videos for two days, which means more money. King Video on North Main street offers one day rental if you rent one or two videos. If you rent three or more you get an extra day free. The Kroger grocery store, next to the University Mall, and the Hethwood Express, located in the Foxridge Apartment complex, also offer movie rentals at very reasonable prices.

For more excitement in your evening, there is the Blacksburg night life. The numerous social fraternities that dot the landscape, and bars that fill the downtown, all seek your attention. The downtown area lining College Avenue and Main Street harbors over a dozen bars and restaurants. Appropriately identified students seeking a rowdy and raucous evening flock to Arnold's Bar and Grill, Sharkey's, and PK's. Most of the bars in Blacksburg seek out students. Arnold's and Sharkey's both have dancing when the night sets in. Sharkey's is known for its 911 Challenge buffalo-wing eating competition. Sports aficionados flock to Champ's Bar and Grill to watch football and basketball. In the downtown, South Main Cafe boasts by far the best musical venue. Serving a vegetarian menu daily, the evenings pack in students paying homage to bands both local and visiting. Gibb Droll, Richard Jesse Project and Everything are all regular favorites. Every Wednesday night, The Kind play their Grateful Dead-esque show to a loyal audience. Other bars with regular bands are the Balcony and Pedro's. The Balcony is known for its dime beers starting Friday's at four o'clock. For students who wish to talk without shouting to one other, The Cellar, the Underground, and Ton 80 all cater to patrons seeking a slight-

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MOUNTAIN BIKING:

By Scott Walters

It is a cool fall afternoon on the campus of Virginia Tech. Classes are over and many students are returning to their dorms and apartments. Some, however, grab their mountain bikes and head to the popular trails of nearby Brush Mountain. The rugged terrain of southwest Virginia provides bikers with some of the best riding on the east coast.

Students are drawn to mountain biking for different reasons. Some wish to enjoy the peace of the outdoors. Others just need a place to blow off some college stress, while others seem to be addicted to the natural rush of mountain biking. Whatever their reason to ride, all share in the fun and enjoyment of biking.

Mountain biking is a purely American invention. During the mid-'70s the first mountain bikes cruised down the trails of California. These early fat-tire machines were built by a new breed of bike enthusiasts. The bikes were built out of old used cruiser frames and motorcycle parts. They were heavy and awkward to ride, but their creators had started a new movement.

In the early '80s, mountain biking began to catch on with the masses. Many companies emerged just to cater to the mountain bike scene. Bike designs improved significantly. New materials made the bikes lighter and stronger. Better designs made the bikes perform better. This improvement process continues today and the interest in mountain biking is steadily growing.

The multitude of mountain bikes on the market can leave a buyer spellbound over which one to choose. Bikes come in various price ranges and are made of many different materials. Riders have to decide which model is best for them. The most important aspect of the purchase is the bicycle frame. While components (brakes, cranks, wheels, derailleurs, etc.) can easily be upgraded or replaced, the frame should last for many years.

A variety of materials are used in mountain bike frame building. Each possess certain characteristics, such as strength, durability, and stiffness. Frame builders and bike riders all have their own opinions as to what is the best material. Dr. Ronald Landgraf of Virginia Tech's Engineering Science and Mechanics department believes that any material can be used as long as the frame has a good design.

STEEL

Steel is by far the most popular frame material. Its properties and traits have provided it with a long cycling heritage. Steel is relatively inexpensive, strong, durable, and easy to work with. According to Dr. Landgraf, steel is three times as strong as aluminum, three times as stiff, but three times as heavy. Bike frames are generally made of two types of steel: high tensile and chromolybium (cromoly for short). Both are alloys of pure steel. Cromoly has more alloys which result in a stronger steel. Less can be used in the frame, hence a lighter bike. High-tensile steel is found in less-expensive bikes. As the cost increases, so does the amount of cromoly.

A common practice in full cromoly frames is to use butted tub-

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Beyond Brush Mountain

Photo by Kacy Jahanbini

Tech's GREAT Outdoors

By Jay Arnett

The next time you catch yourself saying, "Man, there's nothin' to do in Blacksburg," take time to contemplate the endless adventures on bike or foot that southwest Virginia has to offer.

As is often the case, nature's beauty is taken for granted by those who never venture beyond the familiar routes between their homes and Virginia Tech. People from all across the country flock to this exclusive corner of our state for its camping, hiking, fishing, and biking.

Local favorites of many students include the Cascades, Pandapas Pond, and Mountain Lake. The Cascade Falls Recreation Area is located in Pembroke, about 15 minutes away on Route 460 West. This attraction offers a breathtaking view of a 60-foot waterfall with a leisurely four-mile loop. At the base of the falls is a pool in which few can resist taking a cool, refreshing dip during the warmer months.

Pandapas Pond offers a number of mountain biking trails for all to explore that extend along Poverty Creek and Brush Mountain. It is a mere three miles outside of Blacksburg up Route 460 West. For those wanting more of a challenge, it can also be reached by access trails which can be picked up just outside of campus. The eight-acre man-made pond is at 2200 feet elevation and is surrounded by Appalachian hardwoods and pines. The one-mile loop around the pond offers students a great place to stroll with friends and walk their dogs.

If by some chance you end up off the beaten path while exploring the numerous bike trails, it is helpful to find a creek and follow it downstream back to the pond (it worked for me!). In addition to biking and walking, Pandapas Pond also provides warm water fishing and canoeing opportunities.

The Mountain Lake Resort offers hiking and cross country skiing, as well as being a world-class place to lodge and dine. Being featured in the movie "Dirty Dancing" only adds to its fame. Sunday brunch at the Mountain Lake Dining Room is a perfect way to spend time with that special someone.

The War Spur and Chestnut Trails form a 2.5 mile loop through a portion of the Mountain Lake Wilderness Area to War Spur Outlook, which offers an incredible view of the valleys below. These trails are two miles north of Mountain Lake off to the right. To reach Mountain Lake and the resort from Blacksburg, follow Route 460 West for about 15 miles to Route 700 where you take a right and follow the signs. Total travel distance is only 21 miles and is well worth the trip. I can offer a word of advice—don't assume the weather on Mountain Lake is identical to the weather

here in town, especially during the winter season. This mistake could result in having your car stuck in two feet of snow after sliding off the road (and yes, I did experience this first-hand.)

Another favorite of students and residents alike is tubing down the New River. This is an excellent way to beat the heat and relax in the sunshine.

For just a couple of dollars, you and your friends can drift down the historic New River and enjoy the picturesque scenery along the banks. Towards the end of the run, you will encounter mild rapids that are guaranteed to give everyone a thrill.

For great hiking, the Appalachian Trail is a public footpath that stretches across 2100 miles of Appalachian Mountain ridgelines from Maine to Georgia. Blacksburg's close proximity to this natural wonder offers students a multitude of day hikes which run along sections of the AT.

Angel's Rest is a rewarding overlook that can be reached along the AT as it ascends Pearis Mountain. The trail passes through rhododendrons and azaleas as you reach the top of the mountain. The elevation change of 2000 - 3550 feet along 1.5 miles to the top classifies this as a steep climb with an inspiring view from the rock ledges above.

Kelly Knob in Craig County follows the AT up John's Creek Mountain along a moderate two-mile climb. The trail leads to the site of a former firetower. Blue-blazed side trails cross the AT just before Kelly Knob. This leads to views of Salt Pond Mountain and to a bog known as Big Pond.

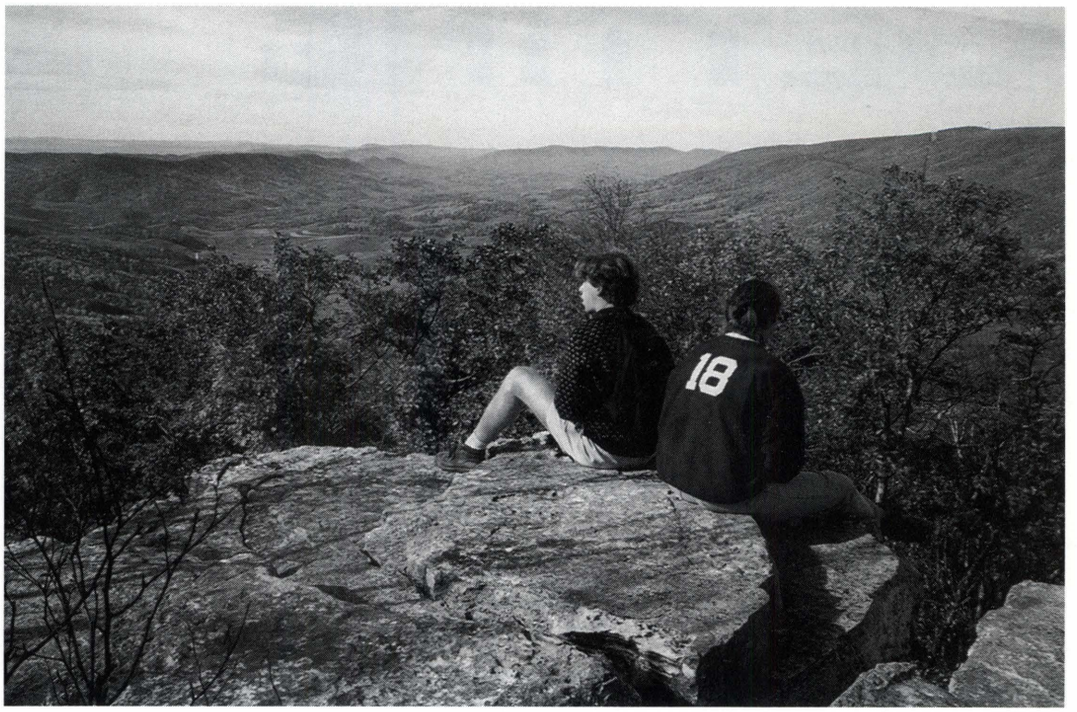
The Audie Murphy Monument is located along the AT and honors the most decorated soldier in World War II. The monument was erected in his memory at the site where Audie Murphy died in an airplane crash on May 28, 1971. Trails behind the monument lead to overlooks that provide excellent views of Sinking Creek Valley. These three hikes along the AT are all less than 25 miles from Blacksburg and are just a few of the many that can be experienced during your time spent here at Virginia Tech.

As you drive towards Roanoke on the backroads, you pass Dragon's Tooth and McAfee's Knob, two hikes which offer breathtaking panoramic views of the rolling peaks and valleys that seem to extend long past the horizon.

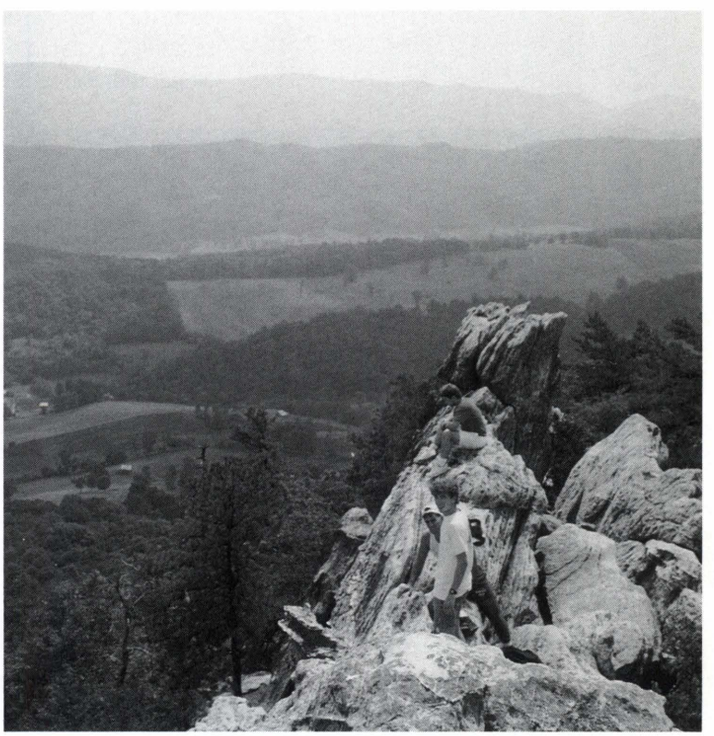
A good resource for equipment and camping gear is the Virginia Tech UUSA Venture Out Outdoor Equipment Rental Center. For a small fee, students can rent everything from backpacks and tents to canoes and caving helmets. Venture Out also sponsors outings such as ski trips in the winter and Spring Break High Adventure excursions.

There is so much to explore and discover here in southwest Virginia. It is sometimes helpful to leave your cares behind and head to one of nature's great creations.

Further information about these and other trails can be received from the Blacksburg Ranger Station.



Nature's Majesty: *Tech students enjoy the outdoors of southwestern Virginia at (clockwise from above) Kelly Knob, Dragon's Tooth, McAfee's Knob, and the Peaks of Otter. All photos courtesy of Mike Reese.*



Getting to Mars

By Ray Easterling

A journey to Mars hinges not only upon design and aerospace engineering, but upon human factors considerations as well.

A panel of experts convened recently at the Third Annual Mid-Atlantic Human Factors Conference at Virginia Tech to discuss the feasibility and factors inherent in a manned voyage to Mars.

The focus of the symposium concerned the incorporation of human factors, psychological aspects, and social dynamics into a prolonged space exploration voyages.

"We want to go back to the moon, to Mars, and then to the stars," said Patrick McGinnis, flight surgeon for NASA. McGinnis gave a tentative schedule for returning to the moon by 2003 and then going to Mars by 2014. "I find this doubtful. NASA has put its mission of strategic exploration on the back burner."

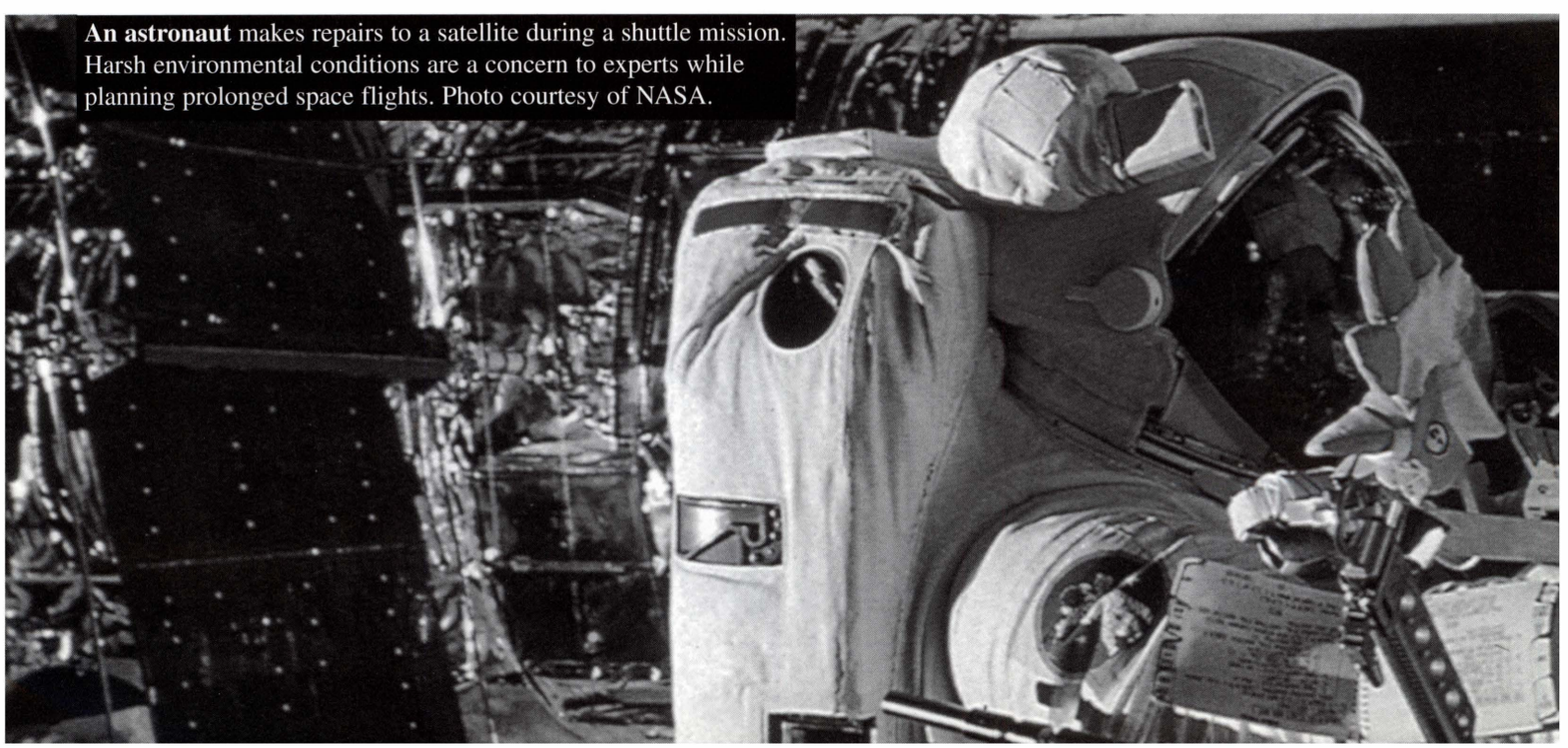
"It's a sad situation," said Jon McBride, shuttle astronaut. "It's unfair that NASA has to compete with [other government programs with dissimilar functions]," McBride said.

McBride, who served for three years as NASA's representative for congressional relations, pointed out that most congressional representatives might be concerned with the next two years of their terms, rather than a scientific operation which may take decades to produce results.

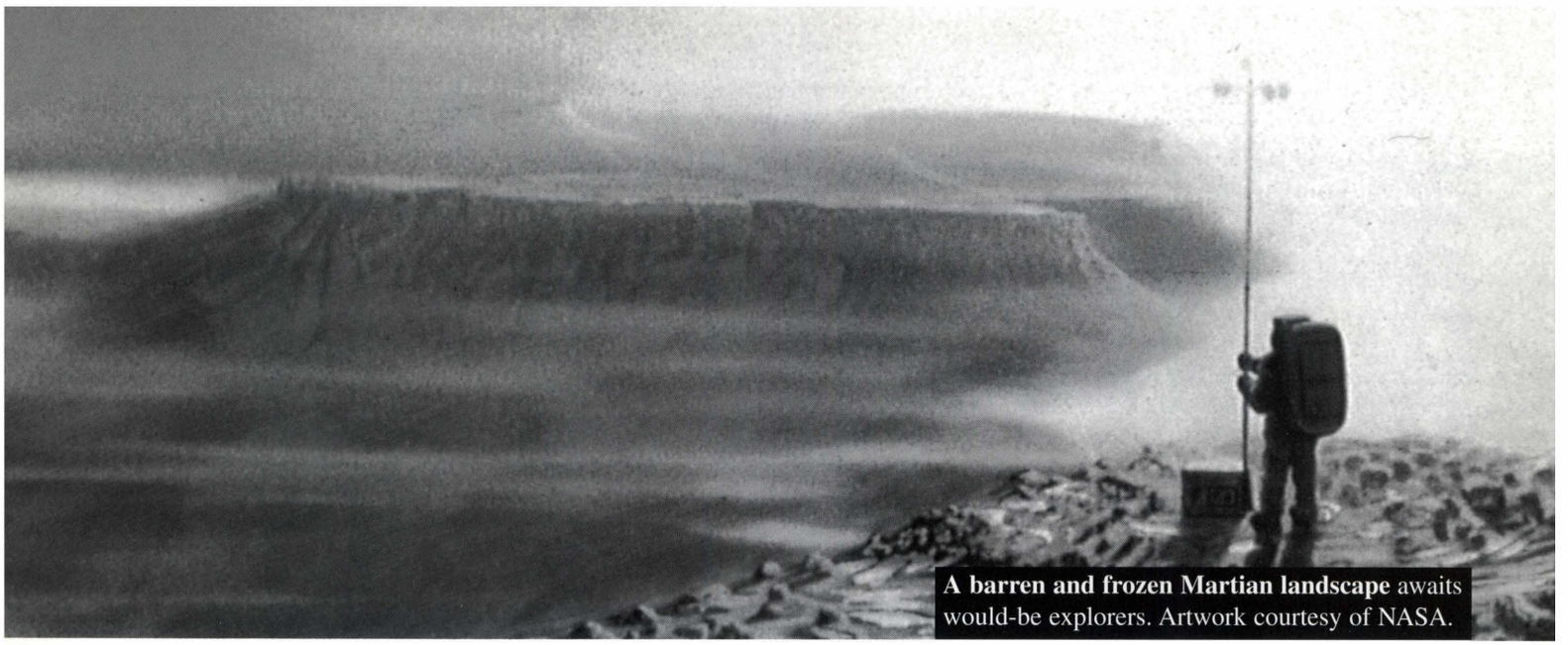
"I'm not convinced we have the political will to sustain a Mars effort at this time with these deficits we're running in the government," said Dwight Holland, a current Cunningham fellow in the Virginia Tech department of industrial and systems engineering. Holland was part of an Antarctic expedition, spending three months at remote field sites.

"[Going to Mars] is going to be the most difficult thing we ever do," McBride said. "It's not the designing and engineering, it's the human factors aspect [which will be the most difficult part]."

The topic receiving the most attention was the issue of prolonged living in an isolated confined environment. It is estimated



An astronaut makes repairs to a satellite during a shuttle mission. Harsh environmental conditions are a concern to experts while planning prolonged space flights. Photo courtesy of NASA.



A barren and frozen Martian landscape awaits would-be explorers. Artwork courtesy of NASA.

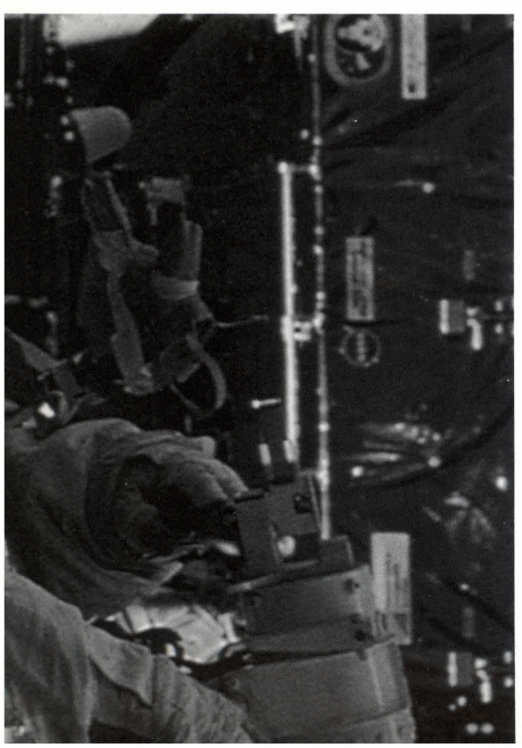
to take 500 days to journey to Mars, which would be followed by a six to twelve month stay on the planet, followed by a return trip of an additional 500 days.

"Significant psychosocial stress will occur on long duration space flights," said Holland. "How will the crew handle the problems when—not if—they occur."

History has shown people in isolated, enclosed environments do not fare well unless able to leave those environments, even with the best selection and training, Holland said.

"The hardest thing during a flight is keeping good relations going with the ground and among the crew . . . the flight becomes increasingly difficult," stated cosmonaut Lebeder during a 211 day mission.

"We have to solve our [problems] together, taking into account the feelings of the other. Here we are totally alone. Each uttered work assumes added importance," said cosmonaut Valery Ryumin, indicating the fragile social state of crew dynamics on prolonged missions.



In direct support of this, Taber MacCallum, president of Paragon Space Development Corporation, cited his personal experiences during two years of isolated and confined environment habitation in Biosphere 2.

"The biggest problem by far was the internal psycho-social dynamic, caused by the difference in opinion of how to run the project," MacCallum said. "Health and social safety were jeopardized to an unacceptable level."

He said the eight member crew essentially split into two groups of four during isolation in the biosphere, located in Arizona. The rift is still evident in the group members, even though they have been out of the biosphere for more than 18 months.

"We thought we knew who we were going in with," MacCallum said. "When we went in, we were all very good friends. Despite ideal conditions, we had major problems."

These considerations, past experiences and research, and new innovations all need to be taken into account in planning the mission to Mars, or any prolonged, isolated event.

"Why is this important?" McGinnis asked. "Well, our workers in space are some of the most valuable industrial workers we have. Not only are they smart and well trained but there's a lot of infrastructure that goes into helping them do their job."

Astronauts will be exposed to adverse temperatures, atmospheric conditions, decompression sickness, microbiology and toxicology, restricted habitability and restricted hygiene, McGinnis said. Physical deconditioning, existence of a closed support system, radiation, and limited escape capabilities will all add to the already heightened stress levels of the crew. Additionally, it is expected that astronauts on a mission to Mars will be exposed to dangerous levels of cosmic radiation.

Irritability, anger, and hostility, research has indicated, are directed towards outsiders during the first 90 days of a mission. Afterwhich, these emotions tend to turn inward on other crew members, McGinnis said.

"You have tensions and conflicts withing the crew which have indeed disrupted missions to the point of premature termination," McGinnis said. McGinnis indicated that countermeasures need to be implemented to negate these effects.

The five member panel, which included McGinnis, McBride, MacCallum, Holland, and Jim Muccio of the University of Virginia Medical College, discussed several solutions and considerations to realize in planning prolonged, isolated habitation. The majority of these involved definite human factors consideration in the space program, an aspect which is threatened under the current economic climate.

"It's the human factors that will drive these long duration space flights," McBride said.

Guide to Blacksburg

Continued from page 3

ly more relaxed atmosphere. The Cellar is distinguished by the accomplished jazz and folk bands that it hosts while the Underground and Ton 80 stand out for their dart lanes and dart competitions.

If you need to get out of the dorm to study, there are a number of calm places where you can sit and read. Mill Mountain Coffee on North Main offers java and quiet environs. Closer to campus are Gillie's and Bollo's restaurants. Gillies, offering vegetarian cuisine, is loved for its ice cream and biscuits.

In addition to the many effervescent clubs, several good restaurants can be had on a student's budget, in addition to those previously mentioned. Backstreets Pizza and Restaurant is famous for its pizza buffet on Tuesday's and Wednesday's. Backstreets also prides itself on the selection of imported beer it offers. Students with a taste for food from south of the border make regular outings to Pedro's and El Rodeo. If take-out is more your style, then fast-food joints are always handy for those with limited time. The ever-popular Macado's chain recently moved to a new and considerably larger building to accommodate its patrons. Despite this expansion you can still expect an hour wait after football games. Bogen's is another excellent restaurant, although it's slightly more expensive than some others. For the most unabashedly gluttonous and by far best food in the area, The Homeplace cannot be beaten. The Homeplace is an all-you-can-eat southern style restaurant. This restaurant resides down Rt. 311 in Catawba, but for directions just ask any upperclassman. The Homeplace starts serving at four o'clock, so be there early to avoid a wait.

Working out and playing sports is a big part of Tech students' lives. War Memorial Gym offers weight lifting, Nautilus machines, swimming, racquetball, walleyball, basketball, and aerobics. If you like your sports outside, there are basketball courts and sand volley ball courts outside many of the dorms. Tennis courts are located next to Lane Stadium and on the Upper Quad. In addition, there are clubs and intramurals for many other popular sports. Tech also offers an on-campus eighteen hole golf course available to all students. For sporting equipment, try CMT Sports on South Main Street.

Like most colleges, Virginia Tech has a large number of varsity sports to watch, and, for the athletically inclined, participate in. Students can enjoy football at Lane Stadium in the fall. In the winter, Tech's NIT championship basketball team will play at Cassell Coliseum. Not to mention soccer, baseball, field hockey, lacrosse, and a wide variety of other sports at various times of the year. All students get free tickets to the games with a student athletic activities card. These cards can be obtained during check in at the beginning of the year. There are plans, however, to use Tech-issued student I.D.s for entrance into football games.

Bicycles abound on Tech's campus. Students use them for transportation, leisure, and fitness. Blacksburg has two bike shops to support the cycling needs of students: East Coasters on North Main and Unicycle on Draper Road. East Coasters and Unicycle offer a good selection of low to high end bicycles and accessories.

Blacksburg's surrounding area offers some excellent outdoor opportunities. Hiking, rock climbing, kayaking, rafting, canoeing, biking, caving, skiing, and snowboarding. Countless hikes offering spectacular views can be found within a short drive of Tech. Local trails and roads provide riders with miles of good mountain and road biking. Nearby Brush Mountain is a favorite for local mountain bikers. The New River, Mountain Lake, and Claytor Lake offer boating and fishing possibilities. The New River, near the town of McCoy, is also popular for tubing when the weather turns warm. Fools Face just above the river in McCoy is a favorite climb in the New River Valley. Climbers can find a number of other climbs within short drives of the campus. About an hour away in West Virginia is the New River Gorge which has some excellent white water conditions. Cavers can enjoy a number of caves in the area. During the winter, skiers and snowboarders can take advantage of nearby ski resorts. Nearby West Virginia has a number of excellent resort. If you're in need of outdoor gear, head to Blue Ridge Outdoors on Draper Road or Back Country Ski and Sports on 460. Back Country also sells canoes and kayaks.

If your interest is in expanding your music collection or getting the latest albums, then the Record Exchange on North Main or Books, Strings, and Things on Draper Road can help you. They carry a wide range of new compact discs. Including many albums by local bands and small bands that frequent Tech. In addition, the Exchange buys and sells used CDs. This is good if your strapped for cash and you have a lot of CDs, particularly ones that you don't listen to any more. Another nice feature of the Exchange is that you can listen to anything in the store before you buy it. For instrumental needs, check out Mainstream Morrell Music on North Main. They buy and sell new and used equipment and offer repairs and rentals.

If a new wardrobe is what you need, Blacksburg has got you covered. Eagle Express on North Main offers casual and outdoor clothing. For more unique apparel, check out Urban Elvis on North Main or Native Cotton on College Ave. Elvis offers modern alternative clothing and footwear, while Cotton has more earthy neo-hippie wears. If your style leans more towards the grunge punk scene head to the Green House on College Ave. They also carry skateboards and snowboards. If your wardrobe is thin, like your wallet, then go to the YMCA Thrift Store. The thrift store is also a good place to put together costumes for Halloween and theme parties. The Sport Shack on South Main sells sports team clothing and athletic footwear. For official Hokie garb try any of the three off- and on-campus bookstores.

If Blacksburg's stores do not have it, then nearby Christiansburg will. The New River Valley Mall offers department stores like JC Penney, Leggett, Peebles, and Sears. In addition there is a Walmart, a K-mart, a Lowe's, and a number of other large stores in Christiansburg. Walmart and K-mart are great places to get stuff really cheaply. If you're tired of Blacksburg food then try any of Christiansburg's various restaurants. Including some fairly inexpensive all-you-can-eat deals. The Blacksburg Transit, which provides free local transportation to students, provides transportation to Christiansburg. The Two-Town Trolley makes round trips several times a day.

There is no excuse for boredom in Blacksburg. Whether you are hip to the scene or hip to the green, you've got four years to spend here and plenty of things to do. Blacksburg is what you make of it so get up and do something.

The Engineer's Way

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cause of much torment and cursing, but the tools included in the software package are used throughout the curriculum, including math and science courses as well as the basic Engineering classes.

5. AutoCAD?

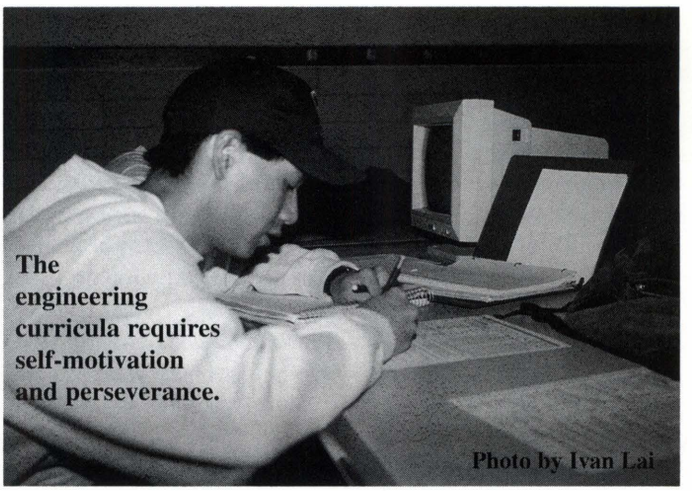
This program is part of the EF 1006 Engineering Graphics program. It will not be used until the Spring Semester and acts along with the engineering kit mentioned previously.

4. How big are the classes really going to be?

The Engineering Fundamentals classes have no more than 32 students. For most, this is the usual size of a high school class. This allows for greater interaction with the instructor and also allows students to get to know their classmates. Other introductory classes such as English and Chemistry can have up to 500 students per class. If a class is scheduled in McBryde 100, it will probably be huge. Most other classes, however, usually range from 15 to 40 students.

3. Am I ready for college?

Classes in college are more difficult from those taken in high school. Dr. Ludwig, the head of the Engineering Fundamentals department, feels that "Engineering should be hard work, but it also should be enjoyable." He has noticed that it takes some time for students to develop, what he calls "an engineering work ethic," but says that the majority are ready for the work after they adapt to the college environment.



The engineering curricula requires self-motivation and perseverance.

Photo by Ivan Lai

2. How are the classes different from the ones I had in high school?

The first major difference between college and high school classes is the fact that college classes don't ordinarily meet every day. It is ordinary to have a schedule that includes only three hours of class a day. Life in college differs because students, especially during the freshman year, live at school. There is no one to check to make sure that homework and studies are accomplished, and there are a myriad of more exciting things to do. Unfortunately, if the more exciting things are chosen over homework, the college experience will come abruptly to an end when the first semester grades are returned. The grades in college classes are based on fewer scores in class. Often the entire final grade will be based on a few papers and the final.

1. How long does it take to cross the Drillfield in the morning?

A moderate pace from War Memorial Gym to McBryde Hall has been clocked at three minutes.

Mountain Biking

Continued from page 4

ing. Butting is the process of tapering and adjusting the interior wall diameter of the tube, while the exterior wall diameter remains the same. The idea is to remove material from areas where it is not needed and keep it where it is needed. Significant weight reductions can be made by butting.

The butting must be done immediately after the tubes are drawn. A mandrill is inserted into the tubes to adjust the internal diameter of the tubing. Single-, double-, triple-, and quad-butted tubing are all used is cromoly frames. Single-butted tubes have one taper at one end. Double-butted tubing has tapering at both ends. Triple-butting is similar to double-butting except the interior wall thickness of the two thicker end sections differs. Quad-butting is the same as triple-butting, but the thin middle section has a gradual taper throughout its span. Frame builders can customize the ride quality of steel frames by mixing the variety of butted tubing.

Steel frames can be built by two methods: brazing and welding. Brazing is the more traditional form of steel frame building. In the last few years, however, it has fallen out of the mountain bike scene. The basic process entails using lugs or fixtures to join the tubes at their junctures. The tubes and lugs are then silver-brazed together at relatively low temperature. Brazing has proven to be a very strong and fairly easy joining method. Because the joints are reinforced by the lugs, thinner tubing can be used. This results in a lighter frame. The one drawback to lug construction is that it has to be done by hand, which increases the price. The tubes can also be directly brazed together without lugs. This process is know as fillet brazing. It is a very time consuming and expensive process, but the joints are among the most beautiful found on any frame. Tig-welding is the most popular form of steel construction. Because the process can be performed by robots, the price of these frames is very low. Improved designs and techniques have allowed these frames to be just as strong as brazed frames. The use of butted tubing has allowed them to be light as well.

ALUMINUM

Aluminum is generally regarded as the next step up from steel. Popularized by a few road bike deviants during the '70s and '80s, aluminum has found a happy home in mountain biking. Aluminum frames cost more, but significantly reduce weight.

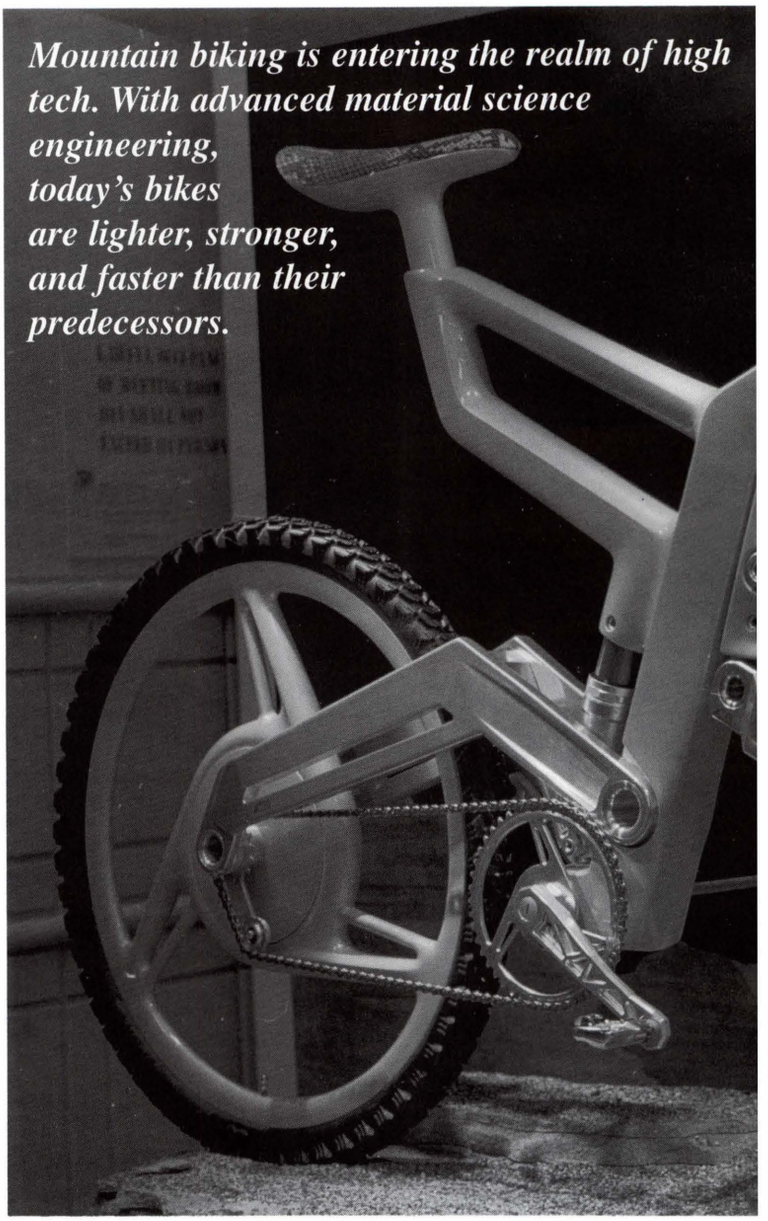
Aluminum also has the advantage of being corrosion resistant. Unlike steel, every spot of chipped paint will not rust. A common myth about aluminum frames is that the frames are very stiff and will beat a rider up. There is some truth in this myth, but is mainly based on earlier frames.

Aluminum is not as strong as steel so more of it must be used in the frame to achieve similar strength. More material results in a stiffer frame. As companies improve aluminum frame designs, they have been able to reduce this stiffness. Internal tapering (similar to butting) and overall design have contributed to the reduction. Aluminum tubing comes in aircraft grade and a variety of manufacturing grades. The aircraft grade has a number of types, but 7075-T6 and 6061-T6 seem to be the most popular for frames. 7075-T6 is the stronger of the two.

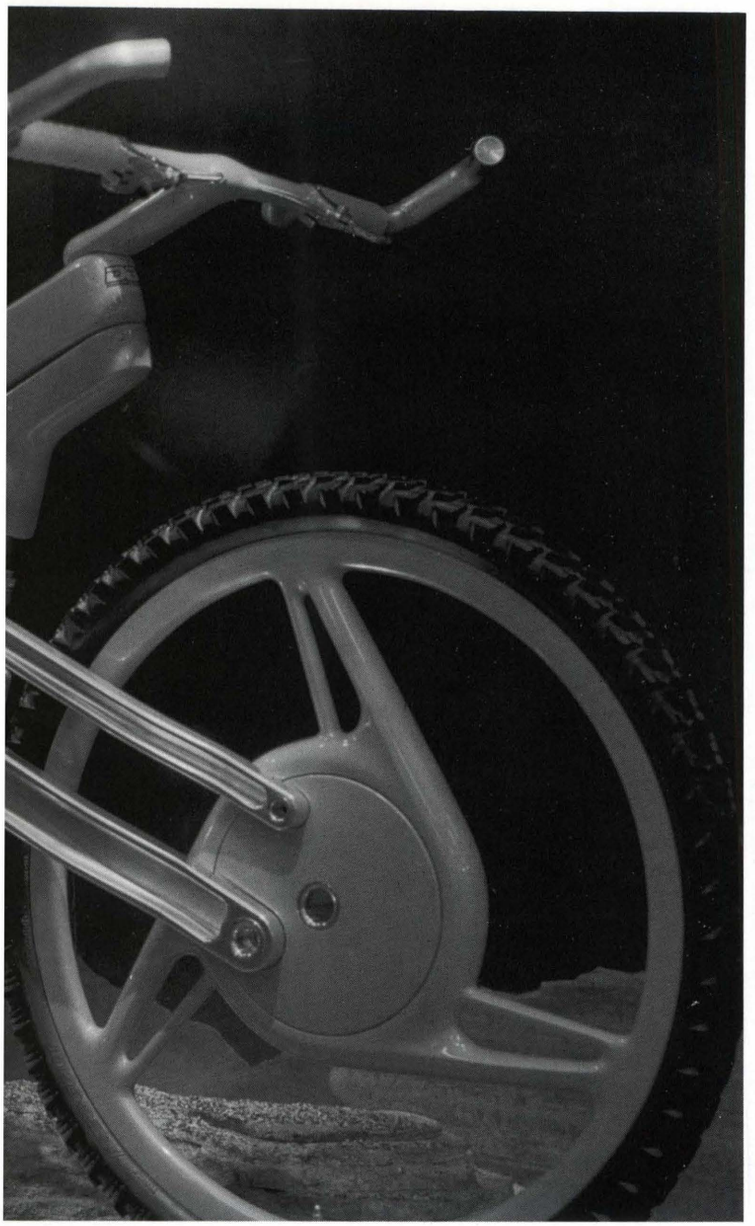
Aluminum frames can be constructed in two ways: welded or lugged construction. Tig-welding seems to be the norm for aluminum frames. Almost all companies use large diameter tubing. With oversized tubes, thinner interior wall diameters can be used. Lighter weights can be achieved without compensation in strength or stiffness. What differs between the companies is whether or not they grind off the welds. By grinding them off, weight can be reduced and frame can be given the appearance of a fillet-brazed steel frame. The downside is that strength is compensated. Companies that choose to leave the joints usually weld them in what is known as a fishscale pattern. In addition, some manufactures choose to add gussets to the joints. This increases the strength but also adds weight.

The other method, lugged construction, is less popular then tig-welding aluminum. Here, aluminum tubes are bonded to aluminum lugs with special types of adhesives. The big advantage is that these frames are fairly inexpensive.

A new breakthrough in aluminum frame construction is the use of metal matrix. Here fibrous materials are added to the aluminum tubes when they are drawn. The result is a



Mountain biking is entering the realm of high tech. With advanced material science engineering, today's bikes are lighter, stronger, and faster than their predecessors.



stronger and stiffer metal. Less material can be used in the frame and lighter weights can be achieved. Also, less material would yield less stiffness. Aluminum frames could be built that are not so hard on the rider.

TITANIUM

The past few years have seen an increase in the popularity of titanium in bike frames. Its light weight traits and strength is far superior to other metal frame materials. On the downside, it costs almost twice as much as other frame materials. The main reason for this is that titanium is very hard to work with and weld. It needs a very specific welding environment and very skilled welder.

Titanium comes in two frame grades: 3Al5V and 6Al4V. These numbers represent the percentage of aluminum (Al) and vanadium (V) alloyed with titanium. According to Dr. Landgraf, both grades are good choices for frame building. In order to make the high cost worth it to the customer, the manufacturer makes titanium frames as light as possible. They can do this because of titanium's high strength. By using less material in the frame, extremely low weights can be achieved. Less material also equates to less stiffness. Titanium bikes generally have a springy feel to them. A few titanium bike companies have recently perfected the process of butting titanium tubes. Supposedly, this process improves the ride quality of titanium. Currently, the tubing is extremely expensive and only available in a few specific frames. In the future, this process will likely become the norm for titanium frames.

CARBON FIBER

Carbon fiber has been used in bike frames for many years, but not until recently has the material made an impact on the industry. The older carbon fiber modes were not designed well and often failed. Companies have spent many years redesigning, and current models have had much better success. The price has also dropped significantly.

Carbon fiber is a very unique material for frames. The fibers must be molded into the appropriate shapes. It is up to the company how the fibers are to be layered and arranged. This gives carbon fiber frames the ability to be extremely strong and lightweight. Plus, the custom arrangement of the material allows for a myriad of ride characteristics to be programmed into the frame.

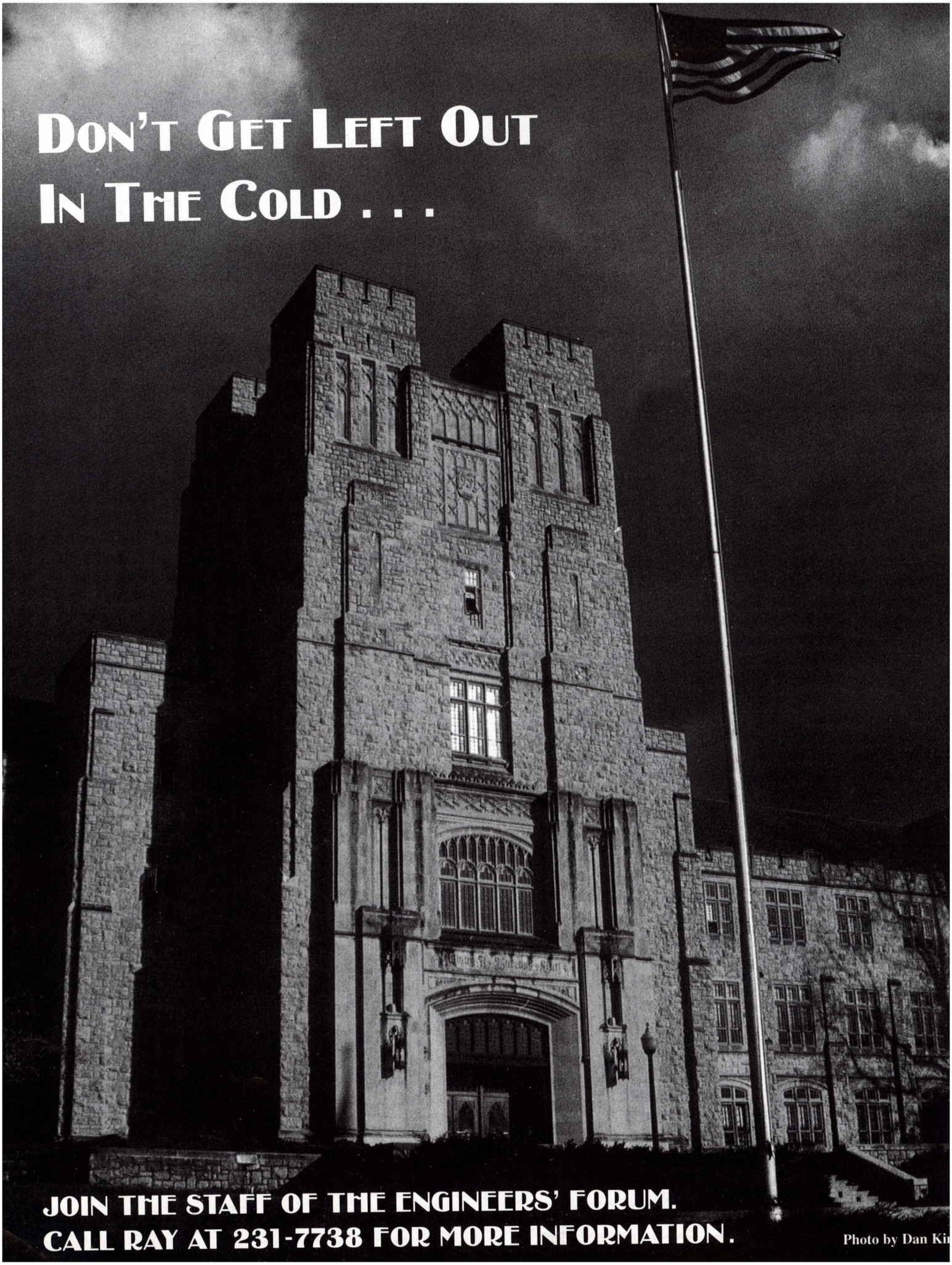
Frames made of carbon fiber can be built three ways: metal lugs and carbon tubes, carbon lugs and carbon tubes, and full one-piece carbon. In the first method, aluminum or titanium lugs are bonded to carbon fiber tubes. This is the traditional method. These are also the same frames with the problems. Many of the bonded tubes were pulling apart from the lugs. Better adhesives and new designs have eliminated these problems.

The second and third methods are similar only in that the finished frames appear to look very similar. The second method bonds carbon fiber lugs to carbon tubes, while the third method generates a one-piece carbon fiber frame. The lugs are formed in molds and the tubes are wrapped. They are then bonded together. By painting and sanding the joints the manufacturer can give the frame the appearance of being seamless. The overall cost of this process is relatively low.

The third method of construction achieves the one-piece design that the lug design only mimics. Carbon fiber is layered into a full-frame mold. A lightweight foam is injected, inflating the carbon fiber and filling the mold. The frame then is allowed to cure. The lugs used in the second method are manufactured in a similar method. The molds and equipment necessary for full-frame molding are very expensive. For this reason the carbon tube/carbon lug frames are more popular.

Carbon fiber has the advantages of weight, strength, and ride characteristics. It does have disadvantages. According to Dr. Landgraf, carbon fiber is a very temperamental material. A nick or gouge in the fiber can greatly reduce the strength, possibly leading to frame failure. Paints and special protective coatings have reduced this possibility.

A few years ago, titanium and carbon fiber were the new experimental materials for frames. Now they are mainstream and just as common as steel and aluminum. New materials, like metal matrix and thermoplastics, have entered the arena to take their place. Companies are currently experimenting with these materials. Eventually, these new materials will also become mainstream as the constantly evolving sport of mountain biking moves forward.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