ENGINEERS' FORUM

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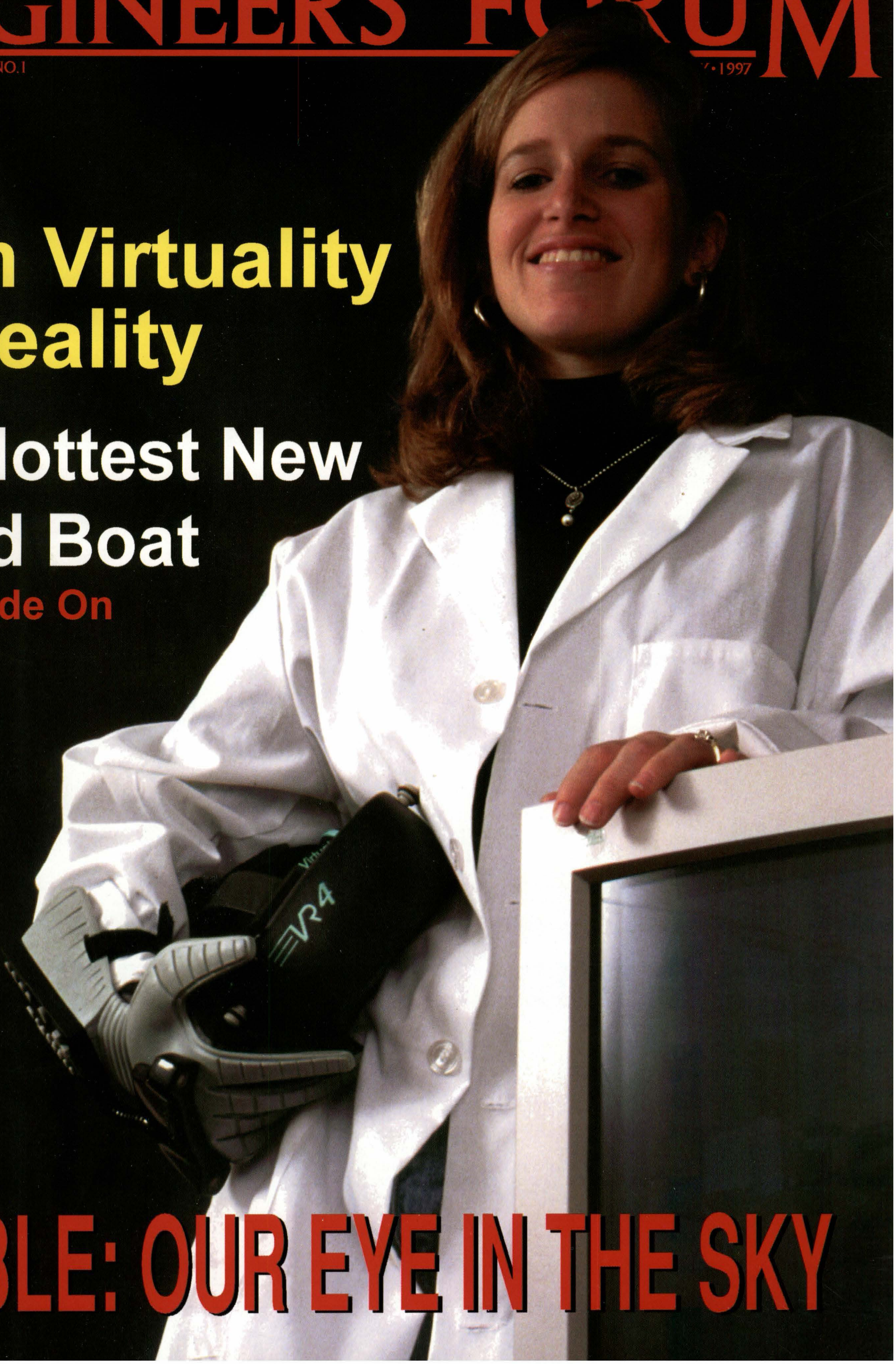

From Virtuality To Reality

The Hottest New Speed Boat

Take a Ride On The B-28

HUBBLE: OUR EYE IN THE SKY

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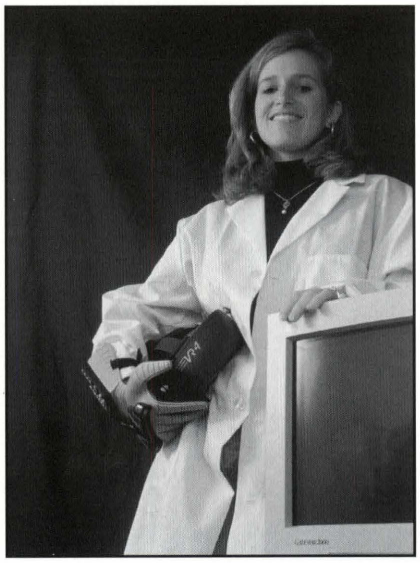


On the Cover

Wired: Virtual reality is just one of the new technologies being researched by the Human Computer Interaction Laboratory.
Model: Sarah Eyler
Photo by Mark Ashley.

Waking Dream

BY
MITCHELL GRAF

RIDING AT 82 MPH across the water is easily the best rush this writer has ever experienced. The most pleasurable thing about that experience was how safe and smooth the boat rode on the water. The B-28 concept design by Ocke Mannerfelt is an achievement in engineering which makes this surety on the water a possibility.

Continued on page 4

Waking Dream

Continued from page 2

With efficiency being Mannerfelt's main objective, he developed the futuristic design shown here.

"I came up with the design by studying dolphins and seabirds," Mannerfelt said.

It certainly did feel like riding a dolphin. At 82 mph, this 28 foot boat's top velocity, turbulence was much less than one would expect. Because of the aerodynamics of the boat, it nearly hovers over the water.

"The boat is generally 90 percent out of the water," Mannerfelt said.

The small wings built into the hull have two purposes. Like a plane, these wings lift the boat most of the way out of the water. This action increases efficiency and speed. The rising effect also adds to a more stable ride. As the boat moves side to side, air flows under the wings to prevent the boat from flipping. When we were turning sharp figure eights at 60 mph, one can feel the boat turning itself upright. This stability was a reassuring factor when hurtling across the water.

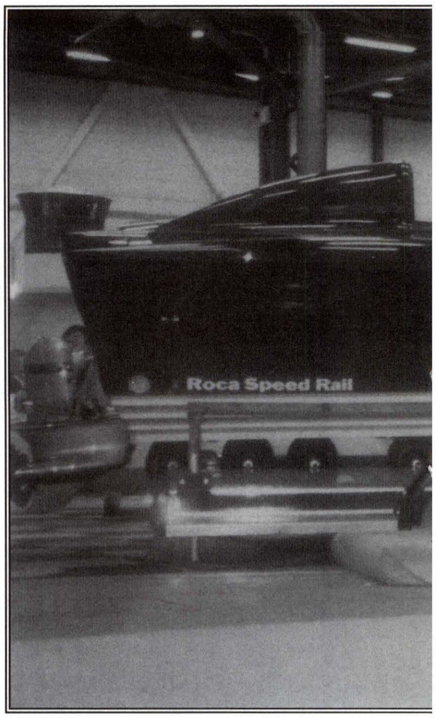
Other speed boats attempting these types of velocities have often had very haunting endings. Boats are known to flip end over end, virtually vaporizing in the crash at such high speeds.

> "I came up with the design by studying dolphins and seabirds"

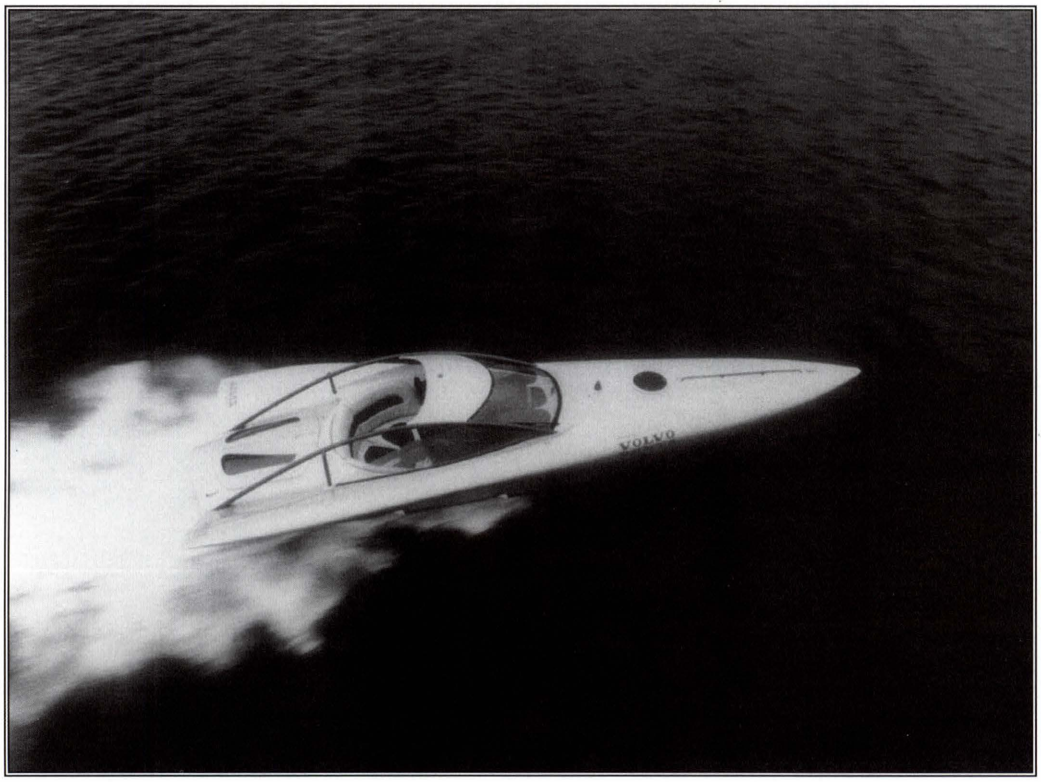
The B-28 has the capability of traveling at high speeds without the use of excessively large engines and amounts of fuel. Therefore, it only requires a 385 horsepower engine built by Volvo Penta. However, Volvo has contributed to the performance of the B-28 in other areas than just power.

Volvo Penta has introduced the dual prop drive to the B-28. A single propeller drive creates a corkscrew effect in the wake. In the dual prop drive, water flows off one blade, and is caught by the second blade rotating in the opposite direction. This action literally straightens the water flow in the wake. The dual prop drive increases efficiency by 15 percent.

Volvo also produces the only hydraulic steering mechanism for this size boat. Combining the Volvo Penta systems with Mannerfelt's design has resulted in the record setting B-28.

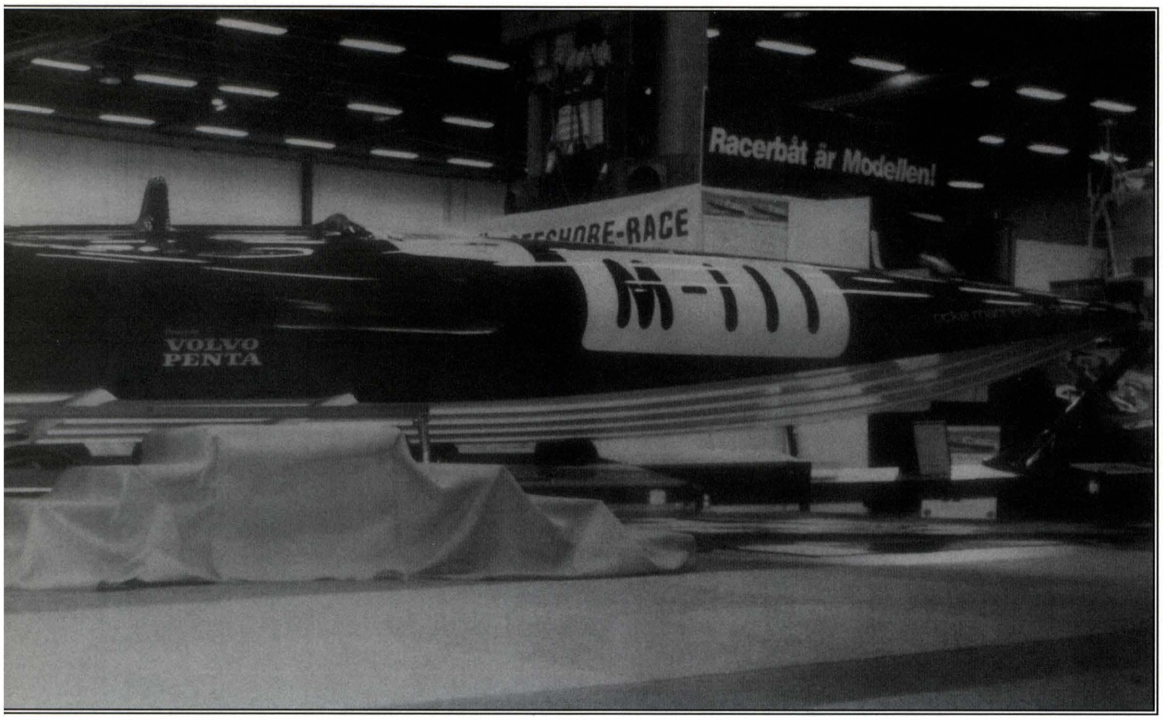


Being a glutton for efficiency, Mannerfelt also developed a new design in hull bottoms. Instead of a uniform body, he designed a hull with steps. The purpose of which was to reduce the amount of friction the water has on the boat. The channels, which run horizontally across the hull, allow pockets of air to flow under the boat The easiest analogy would be an air hockey effect. Although the design doesn't make a frictionless ride, it does add to the efficiency and comfort of riding at these extremely high speeds.



To the experienced boater, riding at 82 mph on the B-28 can be more comfortable than going 40 mph in a lesser craft. Unfortunately, the cost of the leisure model is approximately $70,000. Like all new concepts, eventually this one will become more affordable for the average speed demon.

However, selling the speed boat wasn't exactly



Mannerfelt's primary goal in designing the craft.

There is a sport model that is slightly different from the pleasure craft. It's equipped with a jet-like cockpit and a larger engine. This model is capable of reaching speeds of 120 mph. The sport model was the first to appear with these concepts.

Mannerfelt said "a speed boat is the best way to test my concepts."

By perfecting his design with a speed boat, Mannerfelt could then apply his concepts to other types of water crafts.

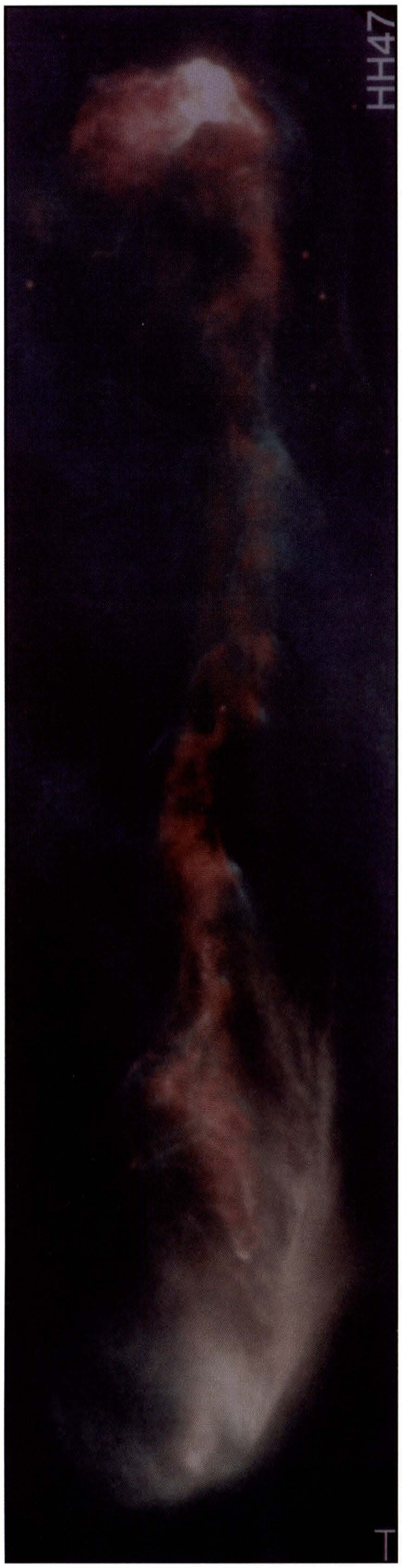
Mannerfelt is applying his concepts to other crafts as well. He has designed a 300 meter freighter with a hull design similar to the B-28's. He said this resulted in a 30 percent increase in fuel efficiency.

The B-28 is a model for boats of the future. If all goes well with this new concept, we could eventually see application of this model to freight, military, coast guard, and pleasure boats.

With fuel efficiency being a major concern for the future, one can see the impact of applying such structural improvements in the way boats are designed and constructed. EF

Photographs appear courtesy of Volvo Penta and Ocke Mannerfelt.

EYE IN THE SKY



ALL PHOTOS COURTESY OF NASA

BY AL LOWAS

When Space Shuttle Discovery launched on April 20, 1990 with the Hubble Space Telescope in its payload bay, the dreams and hopes of many astrophysicists (and possibly the dreams of Hubble himself) were riding in that same bay. After years of delays brought upon by the Challenger disaster, HST was ready to prove its worth. Possibly the most sophisticated civilian unmanned space vehicle built to date, a large number of things would have to work flawlessly, however, if the spacecraft was to be worth anything.

While the satellite's extra ground time (while waiting to be launched) was used for extensive tests and a large number of bugs were found and solved, technicians found problems with the satellite from almost the moment the mission began. Minor problems—a solar panel that would not deploy properly, a high gain antenna that seemed to bind in part of its travel, and excessive jitter from the opening of the aperture door—were able to be corrected with creative programming from the ground. Other major problems did exist, however, and needed to be fixed on orbit.

One of the first problems to appear was an inordinate failure of multiple gyroscopes. While there are six gyroscopes on the spacecraft in three pairs (only three gyroscopes are needed to control the satellite—the other three provide redundancy), half of these failed within the first couple of years on orbit. If any more had failed, the spacecraft would become uncontrollable: obviously, this became one of the most important objectives of the servicing mission.

Even more important, however, was the replacement of the solar arrays. Separate from the above mentioned difficulty in deploying the arrays, they had developed a jitter—an extreme vibration caused, in this case, by differential heating as the satellite passed from the day to the night portion of its orbit. This jitter was becoming so severe that it may have eventually jeopardized the structural integrity of the solar arrays. If this occurred, the satellite would essentially die, critical systems to maintain communications would go without power, as would those systems that protected the sensitive instruments from the harsh space environment. Hence, replacing these was the first task to be completed in orbit.

Of course, the most highly publicized portion of the servicing mission was the repair of the spherical aberration in the primary mirror. The mirror was designed improperly, causing it to be out of focus. Fortunately, as this was a design discrepancy and not a manufacturing discrepancy, the exact amount that it was out of focus was known, and new components could be designed to fix the problem. This was much like the already knowing one's vision prior to ordering glasses, and not needing an eye exam to determine the proper prescription. The two instruments designed to correct this problem were the Wide Field Planetary Camera 2 (WFPC2) and the Corrective Optics Space Telescope Axial Replacement (COSTAR).

WFPC2 was designed to exactly replace the capabilities of the then-orbiting WFPC, but to include its own corrective lenses to better focus the images. As another turn of good fortune, WFPC2 was developed from a spare WFPC unit, developed years ago. The only additional cost—other than that of installation—was to develop and install the corrective lenses for the item.

COSTAR, unlike WFPC2, is solely designed to focus images for other instruments. COSTAR replaced the High Speed Photometer in the satellite (the HSP was returned to earth), and now provides correctly focused images to the Faint Object Camera, the Faint Object Spectrograph, and the Goddard High Resolution Spectrograph. Built by Ball Aerospace, COSTAR places

Continued on page 18

Engineers' Week Tradition Continues

BY
RAY EASTERLING

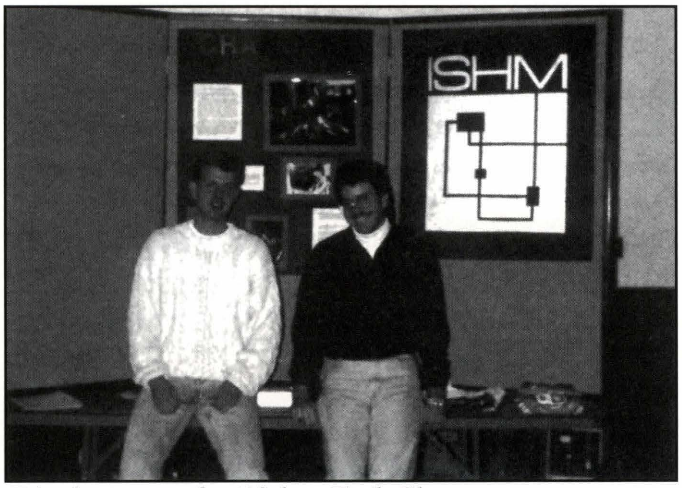
So many things developed by engineers are taken for granted due to their necessity in day to day life. Automobiles, bridges, shampoos, and computers are all available due in part to the work of engineers.

It is for their contributions that a week is set aside to recognize the countless contributions engineers make to society. National Engineers' Week will be celebrated Feb. 16-22 this year.

At Tech however, the Student Engineers' Council is hosting a two week celebration, beginning on Feb. 9 and running through Feb. 20, consisting of activities to help people get acquainted with engineering in general and the university's many engineering departments specifically.

"I have found Engineers' Week to be an excellent opportunity for students to see the different departments and what they're doing," said F. William Stephenson, dean of the College of Engineering. "It's an excellent opportunity for students to see what they want to see and not what we want to show them. There's a big distinction there."

Each department withing the College of Engineering will be hosting information sessions for freshmen engineers. Session typically include information on the department's faculty, job opportunities, and course work. The information sessions run throughout the two-week period and include 10 departments.



Displays are plentiful at Tech Showcase.

In addition to the department information sessions, the two weeks will see other events. The SEC, led by Engineers' Week chair person Jessica Schmidt, hosts a student panel discussion 5 - 6 pm Feb. 9. Upperclassmen will present their perspective of the departments and will be available for questions from freshmen. The discussion will provide an introduction to the departments, Schmidt said.

> ***"Even though the college changes, the students continue [to be leaders]. The SEC plays a big part in that."***

Students can put their engineering talents to the test at the Egg Drop Contest on Feb. 12. Contestants must protect an egg from a fall using limited materials. Winners will be judged based on the weight of the protection device and the degree of damage to the cargo.

The SEC Olympics, held Feb. 15 in War Memorial Hall, are designed to encourage teamwork in the participating engineering groups. The olympic events usually involve field day type activities including challenge courses, tug of war, and volleyball. The cost is $20 per eight person team.

New to the schedule this year is the SES Techwood Derby Feb. 17. This event is similar to a pinewood derby.

Also included in the activities is Monte Carlo Night, hosted by the Tech chapter of the Institute of Industrial Engineers. The event takes place Feb. 18 in the Hancock Atrium. Students can participate in a casino style evening, playing an assortment of dice and card games.

The Tech Showcase will provide an opportunity for engineering organizations to recruit students. The cost is $10 per five person team. The Showcase closes out the SEC sponsored events on Feb. 19 in Hancock Atrium.

"The College of Engineering is fortunate to have such a group of students [as the members of the SEC]," Stephenson said. "The SEC does a first class job."

"We have here, it seems, a tradition of leadership," Stephenson said, indicating the alumni who now head different corporations. "Even though the college changes, the students continue to [be leaders]." he said.

"The SEC plays a big part in that." EF

RECYCLED

Astronauts risk life and limb to take that next giant leap for mankind. The least they deserve is a fresh drink of water, right?

BY SHUVOM GHOSE

Would you pay $5,511.50 for a bottle of imported water? No? What if it had been shipped from over 150 miles away? Still no sale? What if that distance was 150 miles straight *down*?

Even under these conditions, most people would balk at paying such an extravagant price for a simple bottle of water, as did the National Aeronautics and Space Administration when it began to plan its next great adventure, the Space Station Freedom.

Since it costs the agency about $11,000 to launch one kilogram into orbit and the four-member crew of the space station is scheduled to use about 116 kg of water per day, it is simple to see that the cost of resupplying station water from the ground would quickly become astronomical.

Therefore, to cut costs, NASA has decided to not resupply the station at all, with the help of some of the research conducted at Virginia Tech.

When the crew gulps its way through all of the fresh water aboard the station, there won't be a mission launched to refill their tanks, as was done with Skylab. To make things worse, since solar panels will be used to power the space station, those hapless souls aboard Freedom won't even be able to receive potable water as a by-product of hydrogen-oxygen fuel cell operation, as shuttle astronauts can.

So what is the station crew to do? To put it bluntly: drink used wash water from the sinks and showers and their own metabolic wastes such as sweat and urine. Perhaps being an astronaut isn't all it's cracked up to be.

But wait a few minutes before shooting off a letter to Amnesty International demanding they help free these poor space travelers.

Would you pay $5,511.50 for a bottle of imported water?

The situation sounds much worse, or at least unpleasant, than it really is. SSF is to have a fully closed water recycling and reclamation system. That means that any water they use for washing, and any liquids they excrete, will be collected, processed, decontaminated, and purified until it is again drinkable water.

As one can imagine, the system slated to do this is extremely complex, and can be plagued by a host of problems. One of the concerns about the Water Recovery and Management system is the possible unappealing appearance, smell, and taste of water that is perfectly safe for consumption.

Ironically, it is one of the very chemicals used to disinfect the water that causes some of the adverse sensory reactions. Iodine, used as a bactericide in the WRM system, can often leave the treated water with an unpleasant smell or, worse yet, a yellow tint.

To study and solve this problem, NASA consulted experts on the subject, including Andrea Dietrich, an associate professor of Civil Engineering at Tech. And while she did give the current NASA system a grade of "acceptable", it became clear that there just wasn't enough data available on human detection thresholds for iodine and iodine-reaction byproducts in water supplies.

To study and solve that problem, Dietrich began conducting human tests in which a panel of students, faculty and staff from Tech would sniff a range of prepared solutions and rate the strength

WATER?

and quality of their smell. With their research, they hope to pin down exactly what concentrations of unpleasant chemicals in the recycled water humans can detect. In a recent test, the entire panel detected a "noticeably" strong smell coming from a sample containing fewer than 10 parts per billion of idophenol, a product of an iodine-acetone reaction.

Meanwhile, NASA isn't sitting on its hands waiting for a closed-loop water system to come to it. The agency is conducting extensive ground-based tests to find a system that meets its standards, which are sometimes even higher than those the EPA sets for potable public water. Some of the current designs run the collected waste water through a filtering screen, then past a presterilizer which heats the water to 250 degrees Fahrenheit for 20 minutes.

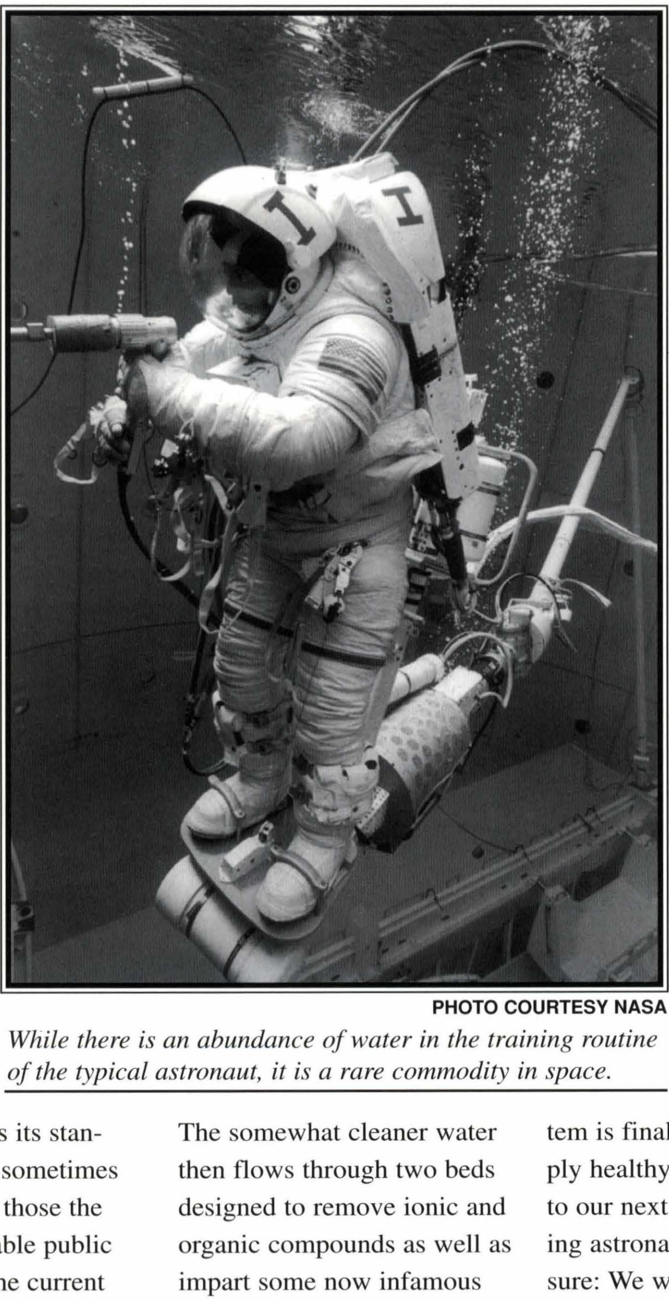


PHOTO COURTESY NASA

While there is an abundance of water in the training routine of the typical astronaut, it is a rare commodity in space.

The somewhat cleaner water then flows through two beds designed to remove ionic and organic compounds as well as impart some now infamous iodine to the stream. The water is then saturated with oxygen, heated again, and passed through a catalytic reactor to oxidize any remaining organics.

Looking even farther into the future, some have proposed that NASA should use the natural recyclers of water found here on Earth, such as soil, microbes, and plants, instead of cold, unfeeling machines, in its long-duration space missions. Such systems still require much development prior to implementation aboard an enclosed environment such as the SSF and carry their own particular handful of problems as well.

However, no matter which system is finally chosen to supply healthy liquid refreshment to our next batch of pioneering astronauts, one thing is sure: We will have certainly come a long way from orange Tang. EF

From Virtuality to REALITY

BY RYAN MCCLANAHAN

Computers have become an everyday part of the lives of most Americans. We use them to help do tasks ranging in difficulty from launching space shuttles to telling time. Have we pushed the limits of the computer's usefulness? Many researchers believe people have only begun to see what these little integrated circuits can do for the human race.

In recent years the enormous expansion of the Internet, the sharp increase in processing speed, and the growing day to day use of computers has raised the hopes of many who are trying to find new and innovative ways for humans to utilize what today's computers can offer. Some of these researchers can be found at Virginia Tech's Human Computer Interaction Lab.

The HCI Lab, which is located in Whittemore Hall, is a part of Tech's Industrial and Systems Engineering department, and is co-directed by Dr. Woodrow Barfield and Dr. Bob Williges. The research at the lab mainly focuses on two different aspects of human-computer interaction: virtual reality and desktop video conferencing.

The possibilities of virtual reality are limitless. Once the helmet is in place you are in another dimension, a dimension controlled by the computer. Unfortunately, as many of us have experienced, virtual reality can have its drawbacks. The motion can sometimes be jerky, fail to follow your head correctly, or even make the user motion sick. Mike McGee, a graduate student working in the HCI Lab, explained his research as "assessing various factors in virtual environments to help limit negative side-effects like motion sickness." Mike Snow, a graduate of Tech, now working as a research scientist for the Air Force, did extensive research on presence in virtual reality, or the illusion of actually being there, while working in the HCI Lab. Snow weighed the costs of additions to a virtual reality program versus the added perceptual effects. For instance, sounds add a heightened sense of awareness and is relatively cheap to add to a program. Increasing the field of view in a virtual reality helmet, however, can prove to be very expensive.

> "Lack of quantitative measures have long hampered research in this area and the usability of VR systems"

"Lack of quantitative measures of perceived presence in a virtual environment and empirical observations of this phenomenon have long hampered research in this area and the usability of VR systems," Snow said. "We hope that the research done in the HCI Lab will make these systems more usable and allow VR system designers to make informed decisions concerning what is really needed for a given VR application."

The end goal of the virtual reality research is to be able to give recommenda-


MITCH HAZAM

John Kies studies responses to video conferencing.

tions to the designers of virtual reality to improve the quality of the virtual world.

The other main area of research in the HCI Lab is desktop video conferencing, which allows interaction between individuals or groups regardless of where they are on the globe. Video conferencing is used quite often today for families to communicate and for corporations to hold meetings. All a person needs is a small camera, a fast computer, and some software. Unfortunately, video conferencing has its shortcomings as well. The video can get so bad, due to the frame rate, that some people refuse to use it. Jon Kies, a graduate student, is trying to understand how the frame rate effects the willingness to use video conferencing. He has been working on two different video conferencing studies. The first was aimed at finding the point at which the users would accept the quality of the video. He showed people the video at different frame rates and they evaluated the quality. He found that only above 10 frames per second was the video quality acceptable, and of course as the frame rate increased the evaluations also got proportionally better.

Kies' other study looked at how humans react with each other through computers. He placed a group of people in one room and another group in a separate room and they had to interact through the computer via video conferencing. He observed that the people did not behave normally and that the occurrences of side conversations, which are conversations only amongst those in the room, were frequent.

"New communication technologies such as desktop video conferencing enable new and flexible work environments," Kies said. "However we need to use a variety of research methods to help understand how best to configure and apply these complex systems to meet the needs of users."

The rapidly changing relationship between the human race and the microchips is being redefined daily. Those working at the HCI Lab hope to detect and correct many problems that might arise with new technology, so that the relationship will grow and we may someday truly realize how much of a positive impact the computer can make on humanity. EF

MITCH HAZAM

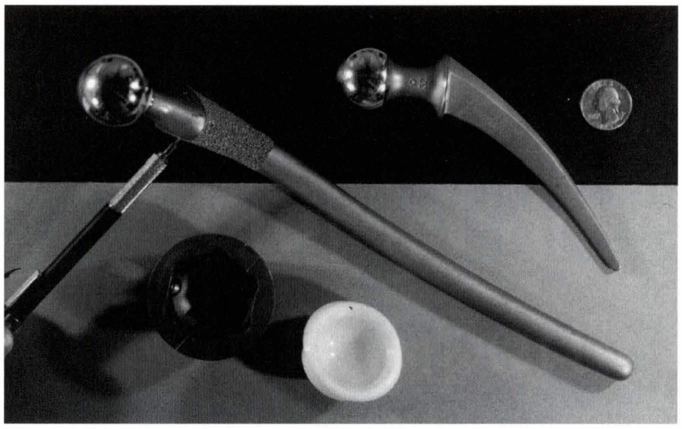
BIOMATERIALS
Are Here to Stay

BY CHRIS PRIMAVERA

The real world has its share of real problems. Just the same, our world searches for real answers. When the search only leads to that which we already know, the need arises for a change. Breakthroughs must be made to ensure the continuance of the progress of modern society.

For years, society has turned to scientist, physicists, chemists, doctors, and surgeons to lend the benefit of their knowledge so that our worries are eased by the fruits of their labor. Well, the world now sees the promise of a new superhero, the biomaterials engineer.

The New Webster's Dictionary and Thesaurus defines biomaterial as a "material suitable for use as a substitute for living material, e.g., prosthetics." Therefore it stands to reason that a biomaterials engineer would be one who studies and develops material suitable for use as a substitute for living material. However, in this modern world of new and extraordinary fields of study, this is not the case. The biomaterials engineer does much, much more. He is the missing link between the clinical, medical world and the world of design. The area of biomaterials is a complex combination of physiologic understanding and engineering expertise. For every new advance in medical disciplines such as cardiology, dentistry, and orthopedics, there are many engineers of various antecedents collaborating to create a final masterpiece. The field of biomaterials calls upon many different aspects of engineering, all working together to reach the common goal of improving the quality of life.


Hip replacements are a common use of biomaterials.

As one explores all this remarkable field has to offer, he or she will find an ascendancy anchored by an array of specific education. At first, the use of man-made materials for physiologic applications sparked a creative fire in the minds of clinicians. Although medical experts could bank the future of their progress in biomaterials on their training as physicians, the future of their success in biomaterials lay in the employment of engineers. Through the collaboration of individual effort and knowledge with a strong push toward teamwork, the fabulous partnerships of clinical crews and design assemblies provides the backgrounds necessary to achieve the desired goals. Engineers provide the key fundamentals needed to aid medical personnel in their research. Through the cooperation of these two phenomenal areas, science has stumbled into a new era, starring the biomaterials engineer.

Biomaterials blossomed from the basic needs of the common good. As a demographic group, the United States is aging. The preponderance of the elderly population has called upon the field to turn to them, creating three main areas of concentration; cardiology, orthopedics, and dentistry. Though cardiology holds the most mystery and urgency for aid, it also boasts high risk factors and numerous obstacles. The delicacy of invasive heart surgery yields an experimental environment surfaced with distraction and restraint. Which only gives way to the exciting options of orthopedics and dentistry.

Common injuries to elderly patients occur mostly in the hips and knees, the supports of much concentrated body weight. Developers of the artificial hip and knee joints use the properties of vibration and control, the fundamental laws of physics and gravity, the analysis of dynamic motion, and properties and behavior of material composites, coupled with an understanding of basic and complex biological systems. The easily accessible oral region has allowed substantial progress to be made in orthodontic adhesives, fixatives, and cosmetic dentistry calling upon a firm understanding of material demeanor, versatility, and longevity.

The scope of biomaterials stretches from a freshman human anatomy course to the ranks of the doctorate-bound. It demands a definite grasp of biology with an equivalent hold in mechanics, materials, chemicals, and electronics. It is therefore blatantly evident that a biomaterials engineer is truly a "Jack of all trades".

No one can better exemplify this than Dr. Brian Love. Dr. Love represents the veritable modern forerunner of biomaterials. His experience reaches the departments of mechanics, materials, biology, and engineering science and mechanics, just to name a few. And his involvement places him in contact with the latest developments in orthopedics and dentistry. Dr. Love understands the need to analyze biological problems from an engineering prospective. He jests, "...so tell me, how do you analyze pain using a stress-strain diagram," and then try to explain that to a clinician.

> "material suitable for use as a substitute for living material, e.g., prosthetics"

The biomaterials engineer must translate their viewpoints into information that physiologists can productively use.

"You have to be able to talk more than one language," says Love, "so that you can speak effectively with doctors, then relay their input back to your design team." If new engineers possess the skill capable of completing this task, the medical world stands to gain considerably.

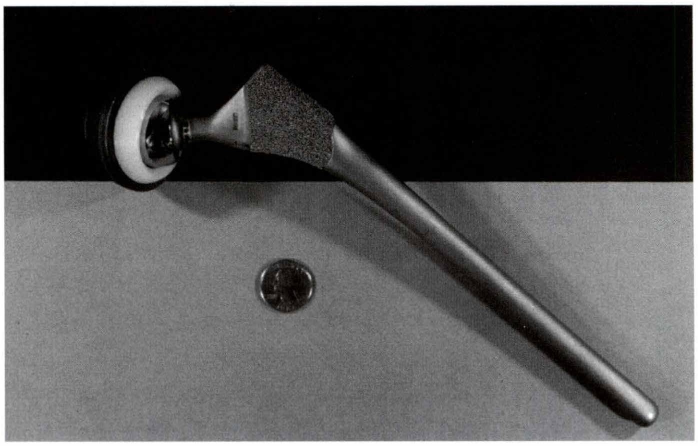
The progress of this pattern over the years has turned the heads of more than a few employers. Large medical companies such as Johnson & Johnson, Bayer, and 3M are devoting time and money to research initiatives geared for teaming clinicians and engineers. The general practitioner will lose ground to people with general knowledge of basic principles, yet concentrated in specialized areas.

Dr. Love said "companies may not know what they are looking for when they say they are needing a certain degree designation."

He emphasized the need for focused research efforts to be entwined in the training of all new engineers. "You define what you can do better than the college," admits Love and highlights the exigency of specific experience in teamwork and development.

Fortunately, an engineer's involvement in the field of biomaterials can start at Tech. The university has one of ten national Societies for Biomaterials to cater to students' curiosity about the field.

The society president, Mike Hayes, said "there's always been a wealth of information and interest in the field."

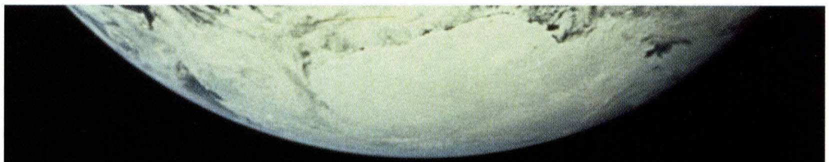


The hip and knee are the most problematic of joints.

Hayes has been with SFB from its beginning in 1993 and has watched the field grow through the years. Now a graduate student, Hayes admits that, "...there's plenty to be done," and counts on the SFB to support that. There are plans in the next year to set up a database of interested companies, fabricate a biomaterials resume book, and provide resume drop for students entering this field. There are also enthusiastic plans to erect a Biomaterials Library on the fourth floor of Holden Hall containing relevant journals, publications, seniors projects, and theses.

While the field of biomaterials is up and coming strong, it is still in its infancy. Although that may discourage a fresh graduate yearning to get into the mainstream, do not shy away so fast. The discipline of biomaterials rose out of an urgent need of mankind. Its tendency to flourish and prosper has earned it the respect of its principle players, and the attention of those that it serves.

Biomaterials deserves the respect and concentration of the medical and engineering communities while relishing the pride displayed by those who continue to pioneer this fulfilling field. EF



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Professor looks to help students reduce stress

New addition to Tech faculty looks to take some of the pressures out of daily life through engineering.

BY MATT KLARA

MITCH HAZAM

Back to work: *Nussbaum specializes in spinal stresses and workplace ergonomics.*

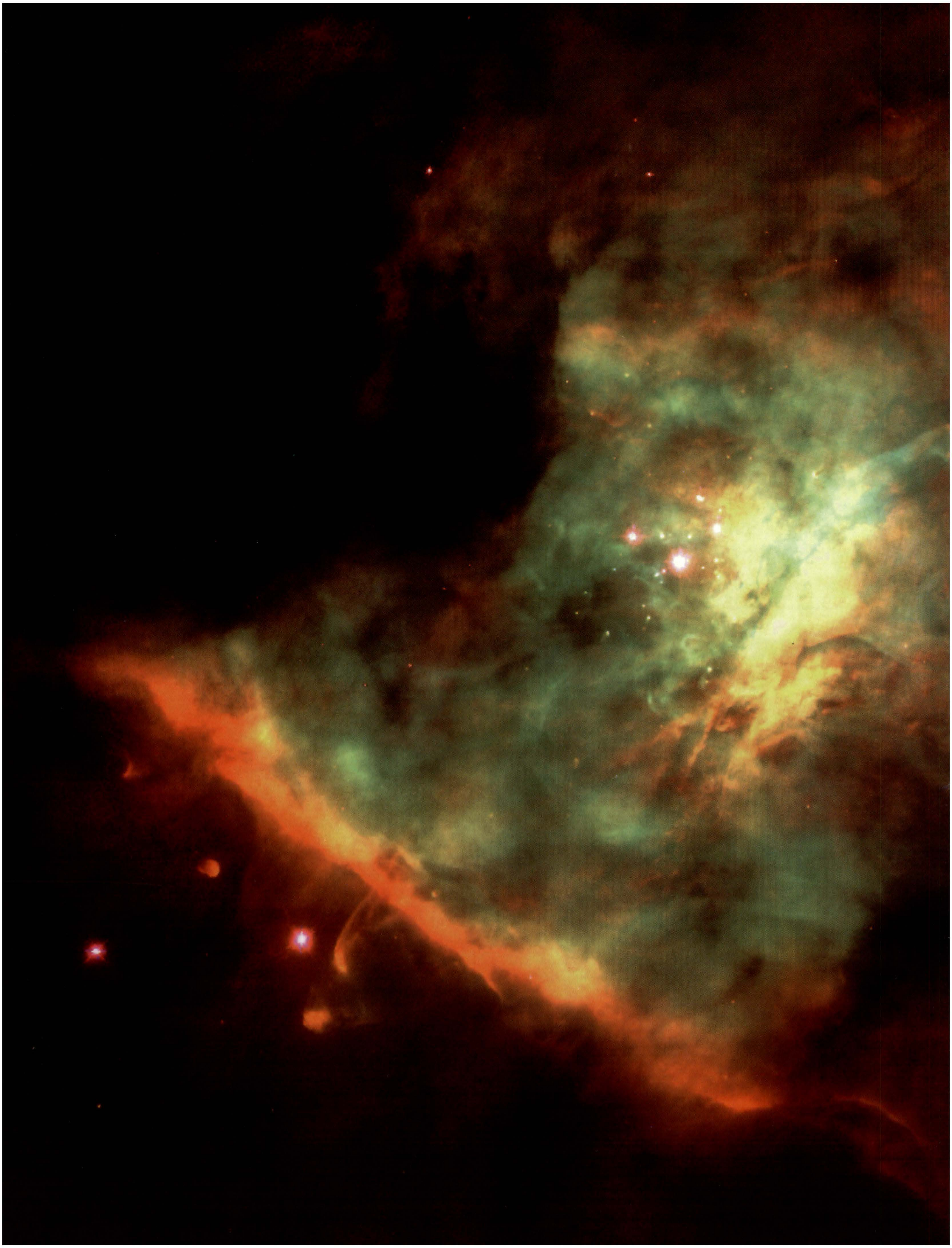
Maury Nussbaum, a first-year member of Virginia Tech's faculty, is proof that engineering is as much human as it is mechanical. As part of the Industrial Systems Engineering department, he specializes in biomechanics and ergonomics. His interests lie in occupational health as well as spine kinetics and kinematics, or the study of the forces and movement of the spine. Nussbaum said his favorite interest is computer modeling of situations that occur in the workplace. The models "pull together all the parts" of his job, he said. All of the concepts and variables he deals with come to reality, or at least virtual reality, in computer simulations. Nussbaum utilizes a program which plots the stresses exerted on the spine when a human performs the task of lifting up and putting down a box. This simulation study was done in order to find a safer way to deal with the load of the box. In fact, most of the research he does is an effort to make the workplace and the jobs done there safer for workers. To Nussbaum, engineering serves to make the jobs that people do safer and easier.

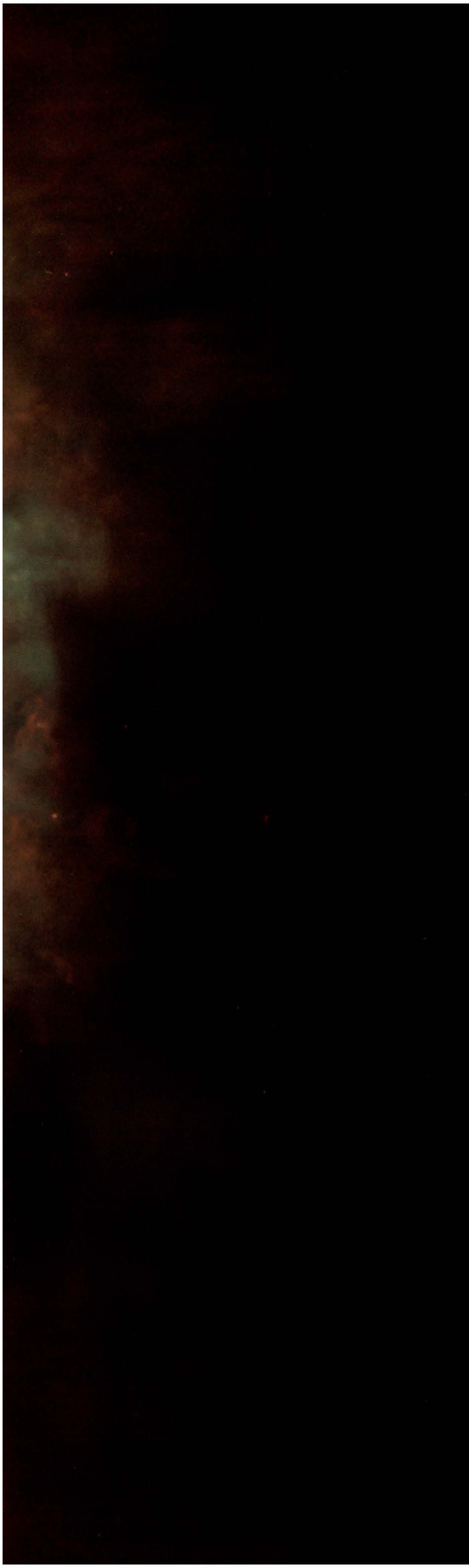
Growing up in New York, Nussbaum believes his love of reading, his interests in science, and the support of his parents were the most influential entities in his life. His dad, a mechanical engineer, believed in fixing things rather than paying others to fix them. Because of this, Nussbaum was always fixing things as a youth. With this background, it is interesting that he had no desire to be an engineer when he was younger. In fact, he had completed several years of medical school at the University of Michigan before deciding to go into engineering. Nussbaum chose teaching as a career for several reasons. He really enjoyed being a student, and the "jeans and t-shirt" lifestyle that goes along with it. He taught classes as a graduate student at Michigan, and is interested by the research opportunities large universities present. His favorite classes are those in which he can talk about what he knows and interact with interested students. At Tech, Nussbaum teaches a class called Work Design. Studies focus on the limitations of the human body as a machine. Included in the class are topics in industrial psychology and worker motivation, the designing of tasks to fit people, macroergonomics and the communications between levels of business, and safety in the workplace. As of this semester, Work Design is the only class he teaches. However, Nussbaum plans to be standing at the front of other classes in the future.

"I will eventually be teaching the undergrad Intro to Human Factors class, as well as Work Physiology and Biomechanics graduate courses," he said.

When he is not teaching or doing research, Nussbaum divides his time among many pastimes. He likes to eat and go to the gym to work out. While he says it makes no sense, it does make him happy. He also enjoys many kinds of sports. When he lived in Ann Arbor, Michigan, he spent a lot of time renovating an old home. Also in Michigan, Nussbaum enjoyed volunteering as an adolescent counselor. He is now thinking of going into the Big Brothers Big Sisters program since he has not been able to find a similar counseling center in the area. Now, he said, he is going through hobbies left and right. His latest is the piano. When asked how his skills as a pianist were maturing, he replied, "I would consider my piano skills at best fair." That's okay, though. Mozart didn't learn overnight, either.

While a conversation with Nussbaum can span topics from mountaineering to photography to favorite music groups, he is definitely a likable and directed individual in all of his many pursuits. What he teaches can be interesting alone, but his personality makes what he teaches that much better. EF





Eye in the Sky

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its small corrective mirrors (ranging in size from a dime to a quarter) into Hubble's optical path with small arms—no larger than an average hand. These will provide corrected images to the other instruments until all are replaced in future missions.

Other primary items replaced during the first servicing mission include:

Magnetometers: The two magnetometers onboard HST essentially serve as compasses, and give added information about the satellite's orientation with respect to Earth. Unfortunately, neither of the original magnetometers worked properly, and both had to be replaced.

Solar Array Drive Electronics 1: One of the drive units for the solar arrays had failed due to overheating. This unit was to be replaced.

Fuse Plugs: Certain of the onboard fuses were sized improperly, and had to be replaced to prevent electrical failures.

While extensive care was taken to plan which servicing functions were more important and to schedule those first in case the shuttle had to release Hubble early for some reason, the entire mission went off without a hitch. Each objective was completed, some in less time than expected.

At a cost of about $692 million to complete the mission, however, some have doubts about its worth. Much of this cost had to be taken from the operations budget of the program, and from money budgeted for future improvements. At the time, there was question about having funding for the next two servicing missions.

Fortunately, however, NASA has been able to solve its funding problems, and each of the next two servicing missions is currently scheduled to go off as planned. The first of these, the second scheduled servicing mission, is to commence with this February's Space Shuttle launch and will further upgrade Hubble's capabilities.

NASA will loft into orbit two main new instruments to be installed aboard Hubble. Each is designed and built by Ball Aerospace, and each will replace a similar package currently onboard HST. Each also contains its own corrective optics for HST's spherical aberration—enabling a later removal of the COSTAR package.

The first of these instruments, the Space Telescope Imaging Spectrograph (STIS) will replace the GHRS package. This instrument can make observations between 115 and 1000 nanometers—and allows operators to select between thirteen separate spectroscopic modes (two high resolution, six medium resolution, four low resolution, and one "objective"). Images will be filtered by one of 65 entrance slits and colored filters, arranged on a carousel like flower petals. What is unique about this system is that it takes spectral images in two dimensions—as opposed to the one-dimensional detectors currently aboard Hubble. This will allow STIS to simultaneously determine the spectral composition of multiple images along the same line of sight—such as the composition of a galaxy, the temperature of a star, and the motion of another star—and to compare them for analysis. This will allow observations to be made of faint images (gas clouds) around bright images (stars) and to possibly find anomalies (a potential to find, for the first time, clear evidence of planets in other galaxies).

The other new instrument to be installed aboard Hubble is the Near-Infrared Camera and Multi-Object Spectrometer (NICMOS). This instrument will allow a capability not currently aboard Hubble, the ability to study light in the 0.8 to 2.5 micron region. The system uses Rockwell-built low-noise mercury-cadmium-telluride detector arrays, and will allow scientists to study deep-space dust clouds and the red-shift phenomenon. As defined by Einstein, objects in space moving away from each other will appear "reddish" when viewed. Each of NICMOS's three cameras contains one of these detector arrays, and a system of 19 filters that can be selected for individual observations. This entire package must be kept at approximately 58 degrees Kelvin to maintain a proper observation temperature—hence it is encased in a solid block of nitrogen within a hybrid Dewar: essentially a liquid-nitrogen filled cooler, in this case specifically designed not to interfere with observations. A key objective of scientists utilizing this instrument is to find and study the epic, that region of the universe where stars and galaxies are beginning to form.

The new instruments will span the light spectrum as never before, and will continue to answer questions from the formations of galaxies, black holes, and stars to the composition of the universe.

Letter from the Editor February 1997

ENGINEERS MUST BE GLOBAL

Personal contact has a sense of permanency that electronic media has yet to garner.

T It is a marvelous time. Technology is proceeding at a rapid, yet controlled pace. New advances are made every day, it seems. We live in a time where we can type something up on a computer, drop it onto the Internet and have associates in Australia, Japan, and England review that exact file instantaneously and simultaneously. It's staggering to think that just a century ago, getting consensus on a proposal from people in those geographic areas would have taken months.

Now we operate in nanoseconds and megahertz.

As computer smart and Internet savvy professionals, engineers are in the position to have a profound effect on the market place of tomorrow. Already we see entire corporations that have no headquarters. They simply operate, meet, exchange information, and get assignments over the Internet from all corners of the globe. This has been a great boon for many new businesses, eliminating the need for excessive capital expense and allowing them to be more flexible, to operate anywhere at anytime.

And while it has its monetary advantages, it has its personal costs, too. How much do we loose from not having that personal contact, now that deals are no longer sealed with a handshake, but rather an electronic transaction? Are we willing to give up the business lunch in favor of an email?

As use of these new technologies increases, the number of personal interactions will decrease. At this point, it will be the technological person who can still talk with a person, not simply type to them, which will actually be in more demand. Think about it: would you be more impressed to receive email from a friend, or a handwritten note? Personal contact has a sense of permanency that electronic media has yet to garner.

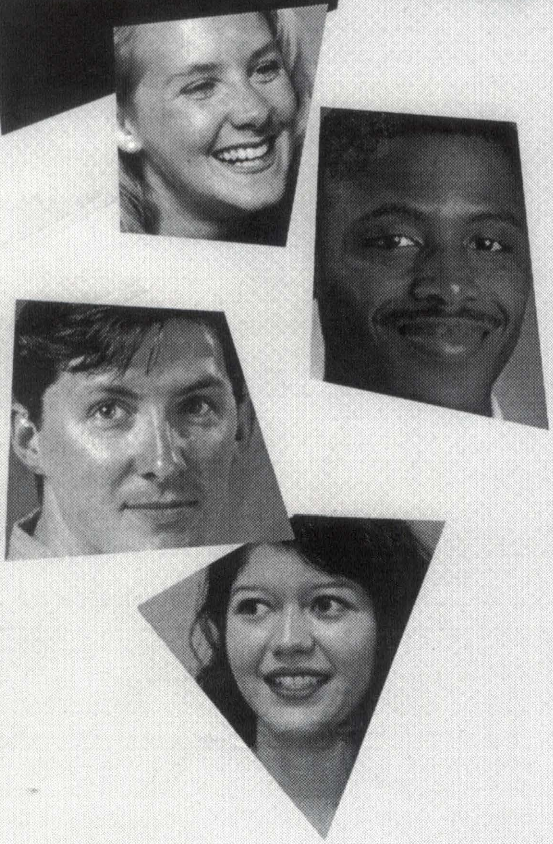
Should we throw out the technology? Of course not. We should use it, but we should do so wisely. Use it when speed and efficiency is necessary, but always remember to take time out to do things personally, too. It won't just make you feel better, it will probably add to your success as well.

And if you think it simply takes too much time to go visit someone personally, just think about how long it took a century ago.

Ray

Ray Easterling
Editor

a passion to be the best



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