When Provost Jo Ann Gora and I began discussing the benefits of establishing the University’s first-ever research magazine, our editorial goal was to produce a publication that provided readers with information crossing a variety of disciplines at a level that was both readable and useful.

As we celebrate our first anniversary of Quest, we believe — based partially on the feedback from you, our readers — that we have much to be proud of. We have created an attractive magazine, you have told us, that both intrigues and informs.

And, perhaps, our greatest form of flattery comes from some of our sister institutions who not only pass on kind words, but ask the question, “How would we get started on developing a similar piece for our campus?”

I advise them first to establish a strong working relationship between institutional advancement and academic affairs and to find people like our editor, James Schultz, and our designer, Sharon Lomax. The next step is to talk with the faculty to find and develop stories.

This time around, we have three faculty-written articles. One, by Physics Department Chair James Cox, is the magazine’s first full-fledged opinion piece. Another, by associate professor of nursing Mable Smith Pittman, goes to the roots of workplace violence and, unlike many other similar stories, actually offers practical tips on prevention. A third story, by Old Dominion professor of English Joyce Hoffman, looks at one of this country’s most startling conflicts, the Vietnam War, and describes the determination of female correspondents who leaped gender barriers without so much as a backward glance.

This issue’s special section highlights the fundamental role physics has played in the development of the late 20th-century technology that we have come to find so indispensable. The section contains another first: brief conversations with four Old Dominion physicists, an “in their own words” approach that makes science understandable.

Those folks fond of gadgets and the future should be especially satisfied with this issue of Quest. A trio of expert prognosticators tell us what we can expect from the local and national economies, while inventors of a deceptively simple device originally designed for space flight describe its terrific terrestrial potential.

You may also notice we have expanded by a few pages. Don’t forget to check out our Web page (http://www.odu.edu/~instadv/quest). In the months to come, we’ll be exploring ways to better connect the text version of the magazine with online resources. We’ll keep you updated on our progress.

John R. Broderick
Vice President for Institutional Advancement

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Opinions expressed do not reflect the official views of the University. For permission to reprint text from Old Dominion University’s Quest contact the Vice President for Institutional Advancement: John R. Broderick (757) 683-3152, fax (757) 683-5513, e-mail JBroderi@odu.edu
WOMEN WENT TO VIETNAM AS WAR CORRESPONDENTS in unprecedented numbers in the 1960s and early 1970s. A combination of intellectual curiosity, professional longings to be at the center of a big story and a simple lust for adventure drew women to the jungles of Southeast Asia, just as those same urges had long drawn men to the spectacle of war.

For a decade and a half, women begged, cajoled or simply paid their own way to Vietnam. Together they transformed the role of women as war correspondents from an aberration to a norm. But very few of them were acknowledged as the professional equals of their male counterparts — then or now.

The military and media worlds female correspondents encountered in Vietnam were a mirror image of those they had left in the States. What they did while they were in Vietnam, says journalist David Halberstam, is only half the story. How, in the male-dominated culture of American newsrooms in the 1960s and 1970s, they managed to get the Vietnam assignment is the other half, he maintains. For women associated with major news organizations, it was a dispiriting ordeal, one that demanded measures of persistence, tact and abundant patience.
Between the Lines

Because Vietnam was the most accessible war in American history for reporters of either gender, women had few problems acquiring accreditation. The press had never before had such complete access in covering any other military conflict. Until 1965, America continued to insist that its role in Vietnam was purely advisory. To have restricted the press or imposed censorship of any kind would have signaled that the Army of South Vietnam was receiving something far more serious than advice.

While the military files are incomplete, available records indicate that upwards of 300 women were accredited to cover the war in the decade between 1965 and 1975. Of these, 300, a total of about 70 women are identifiable as correspondents by their published or broadcast reports about the war. Women acquired letters from organizations as traditional as the North American Newspaper Alliance, as diverse as Mademoiselle and True Adventure, or as obscure as the Lithuanian Daily Worker.

The press identification issued by the Military Affairs Command, Vietnam (MACV), entitled the bearer access to the army's ground and air transportation system throughout the entire country. And that is where it became quite easy for women. Although Supreme Commander General William C. Westmoreland tried — unsuccessfully — to have women barred from overnight flights to the combat zone, he welcomed women, too, precisely because their presence made so many of the commanding officers uncomfortable.

Among their own male colleagues, female correspondents were often welcomed but rarely esteemed. No less than the generals, male correspondents in Vietnam perceived war as a man's game. Among these macho men, the approval of the “grunts” who fought the ground war, and with whom they shared hardships, was a badge of honor. Out on search-and-destroy missions with the troops, you carried your own pack, dug your own trench, fired a .30-caliber automatic at the enemy in the heat of battle if you had to, endured the heat, the jungle, the trench foot and, most of all, the fear.

Many of the correspondents — those whom Michael Herr in his book Dispatches dismissively refers to as “girl reporters” — were estimated among the troops with whom they saw action, and the stories they told enriched the public understanding of the war and its origins. Gloria Emerson of the New York Times, for example, enlivened the fighting man in a different, but no less remarkable way than columnist Ernie Pyle had done in World War II. Dickey Chapelle, a middle-aged freelance photographer, carried her own pack and dug her own trench and died on patrol with her beloved U.S. Marines when a land mine exploded.

Elizabeth Pond and Kate Webb were captured and held prisoner by the Viet Cong, unlike several captured male journalists, they were released unharmed. And, perhaps most notably, Frances FitzGerald explored the complexities of Vietnamese society and concluded (long before many of her male colleagues did) that the war was unwinnable.

Beyond this collective view of the women's movement and a shared desire to avoid each other, there are few other characteristics common to the scores of women who covered the Vietnam war. At the outset at least, most of the women correspondents thought America’s goals in Southeast Asia were both noble and just. Politically, they were both Republican and Democrat. Ideologically, their opinions ran from that of New York Herald Tribune correspondent Marguerite Higgins on the right, who believed Vietnam was “as much a front line of freedom as Hawaii or San Francisco,” to Gloria Emerson's vastly more dovish belief that the war was a huge, unrelenting and avoidable tragedy.

During the two-plus decades after America's withdrawal from Vietnam, years in which women have taken an increasingly prominent role in covering wars, the achievements of female journalists in Vietnam have been considered less noteworthy than those of their male colleagues. Among historians who have written about the war and the media coverage of it, women correspondents are largely ignored or receive only perfunctory mention. Even though women who covered the Vietnam war won some of journalism's most prestigious awards — a Pulitzer Prize and several George Polk Awards, the National Book Award and the Overseas Press Award — their role in Vietnam, at best, remains understated.

In the context of journalism history, these 70-odd women who covered the Vietnam War debunked the notion that women had no place on the battlefield. Thanks to their accommodations in Southeast Asia, the women correspondents who are now routinely assigned to cover conflicts in the Persian Gulf, Yugoslavia, Albania and countries throughout Africa are hardly considered “the girl reporters.”

No soldier would ever shout to CNN's Christiane Amanpour, as a Marine once did to Gloria Emerson in Vietnam, “What the hell did they send a woman here for? War is a man's business!” In Vietnam, women proved otherwise.

Unappreciated Still

Although the inroads achieved by the women's movement in the 1960s helped to compel editors to assign women to Vietnam and forced the generals to suffer women on the battlefield, many of these women appear to have been at the very least indifferent to, if not downright contemptuous of, feminism. Few would credit feminism with any part of their success. They believed instead that they had made it on their own.

Both Emerson and NBC correspondent Liz Trotta challenged the movement's philosophy. Based on her Vietnam experience, Emerson once wrote that no woman who has witnessed how the Army can crush and humiliate an enlisted man can ever muster any sympathy for the women's movement. “The real victims of men,” she concluded, “are the other men.” And in Trotta's case, the “recessively liberal demands” made by leaders of the women's movement “smacked of spatial-interest crankiness masquerading as the people's will.”

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Professor of English Joyce Hoffmann is writing a book on the role and experiences of female journalists in Vietnam.
In an ideal world, automobiles would eliminate air pollution, not cause it. Emissions from backyard grills, lawn mowers and wood-burning fireplaces wouldn’t spoil the atmosphere. Nor would acid-rain-causing, wind-carried contaminants from industrial plants trouble plant and animal life.

Kenneth Brown, professor and chair of Old Dominion’s Department of Chemistry and Biochemistry isn’t about to remove imperfection from the human experience. But a ... and perhaps even curtailing the often acrimonious debate between environmental activists and industrial interests.

Brown and his collaborators have created a catalytic converter that, at ambient temperature and without moving parts or electricity, is capable of removing from gases ... com-ponent in firefighters’ masks and as an add-on application in a variety of situations where air fouling occurs.

“We’re probably one of the few groups in the country to know how to make these catalysts work,” Brown says. “We’ve developed a fundamental understanding necessary to produce concentrated light energy. In order to break apart or recombine gases, the catalyst relies on unique surface chemistry and a formulation that includes platinum and tin oxide incorporated within already available, hon-ecombed ceramic form. Brown, who continues to work as a consultant on the project, attributes the converter’s efficacy to additional, proprietary modifications. “We’re always testing, trying different for-mulations for different situations,” he says. “It’s our secret sauce.”

The converter was developed through the combined efforts of an international team of scientists including researchers from NASA’s Langley Research Center and the Science and Technology Corporation, both in Hampton; Old Dominion University; the University of California at San Diego; and the University of Florida. NASA holds the patents on all derived converter technology, licensing a portion of that technology to STC Catalyst Inc., a company set up specifically to mar-ket certain catalyst applications. “Each [institute] brought different talents to the table. That’s the only way you can get one of these projects done,” says George Wood, catalyst co-inventor and STC Catalyst vice president of business development. “Developing this thing was not easy. It was a hard job. It involved a lot of experimentation and testing. But the end result was that we developed a catalyst that really does work.”

Beyond Theory

One immediate catalyst success has come in the form of industrial lasers, which require repeated and often costly gas recharging. Because the catalyst is able to recombine di-rising gas efficiently, it can reduce replacement costs by as much as 50 percent. In operational terms, this can trans-late into a per-laser savings of thousands of dollars, an amount that rivals substantially for businesses that use dozens of lasers for cutting, welding and drilling.

Because of greater gas-supply costs, overseas firms can save even more, perhaps tens of thousands of dollars, according to STC’s Wood. His firm is aggressively pursuing mar-keting opportunities in Australia, Canada, France, Italy, the Czech Republic, South Africa and Japan.

“We’re still in a startup mode,” Wood says. “It takes maybe three years to fully develop a product. We’re in our second year. Sales are good — and they’re growing.”

Aside from its industrial impact, the converter could have a huge effect on public health and safety. According to

The Journal of the American Medical Association, each year unintentional carbon monoxide poisoning is estimated to cause approximately 2,100 deaths in the United States. Half of all unintentional carbon monoxide deaths could be pre-vented through the use of carbon monoxide detectors. The catalyst could one day function as both detector and purifier in a combined unit that would be widely available to con-sumers. Another conceivable use may be as part of a car’s pollution-control apparatus to vastly reduce or eliminate hydrocarbon-related pollution altogether. In either case, fur-ther technology development will be required.

“There are still important issues to be resolved,” Old Dominions’s Brown says. “One is to improve operational effi-ciency in a high-humidity, ambient-temperature environ-ment. The second is getting materials cost down. Once you do those things, the market is huge.”

For Brown, the value of the catalyst project has been in the practical understanding he has been able to impart in the classroom. Beyond any commercial success, Brown believes the most profound effect may ultimately be on his pupils. “In this catalyst project, we’ve had to decipher how things work. I’ve learned an awful lot from working on the catalysts and I’ve been able to bring that experience into the lecture hall. I’m really able to give students a practical insight that goes beyond the theory.”

Catalyst co-inventors George Wood and Kenneth Brown

By James Schultz
A California father of seven was fired as an airline ticket agent. The agent smuggled a .44 magnum aboard a flight carrying the supervisor who had fired him. After the plane was airborne, the estranged agent shot his former boss, the pilot and the co-pilot, causing a crash that took the lives of 43 passengers, including both the agent and the supervisor.

A civilian employee at Fort Knox, Kentucky, had been passed over for a promotion. Before killing himself, the employee shot and killed three civilian co-workers, including his boss, and critically wounded two others.

A technician quit his job because of the difficulty of working for a woman. He subsequently sneaked back inside his fiber-optics lab, pulled out a 9-mm semiautomatic pistol and began to fire at workers, who ducked or fled or sought shelter by curling up in dosets and file cabinets. By the time he had finished the grim work, two were dead and two were injured. The technician walked upstairs to an office and shot himself in the head.

Workplace anger is not new. Traditionally, however, violence in the workplace was an aberration, such an uncommon occurrence that it captured neither the attention of managers nor the general public. Recently, of course, that’s changed. Anyone watching television, reading the newspaper or listening to drive-time radio can hear stories of this or that worker run amok, armed and dangerous, out to hurt those who have hurt him (indeed, nearly all violent workplace incidents are instigated by males). We now take for granted that work-related frustration can quickly escalate into major outbursts of violence.
SOUR WORK, SULLEN WORKERS

Most people can become angry, even enraged, without expressing themselves physically or through violent acts. Effective anger management can be learned in the home, at school or in the course of normal human maturation. Despite training and intervention, however, not all are capable of such self-control.

Not a few current workers grew to adulthood knowing little, if anything, about how to manage anger. Some were latchkey kids or grew up in dysfunctional, unsupportive environments with poor role models. Such people tend to turn to the workplace for the emotional comfort they crave. Unfortunately, these days, the workplace isn’t able to provide such support. Most businesses are set up to make a profit; inasmuch as workers contribute to the bottom line, they are valued and appreciated. But that is the extent of the commitment.

In the culture in which we live, nearly everyone defines themselves partially or wholly by the professions they practice and the jobs they occupy. Indeed, it can be argued that the near-defilement of work is a social problem. By investing work with the passion that previous generations saved for religious expression, contemporary workers run a severe risk to their emotional well-being if their jobs are put at risk for any reason. Any threat can be quickly perceived as an immediate and direct threat to the self.

The causes of intense workplace anger are several. One primary reason is the end of lifetime employment and security. Downsizing, restructuring and reengineering are turning workplaces upside down, causing workers to become frustrated, scared and, in some cases, enraged. These days, once someone loses a job, it’s difficult to find a comparable one.

In earlier decades, the vast majority of workers who lost their jobs could easily find equivalent ones. Not so now. According to studies done of job loss in the 1990s, fully 90 percent of terminated workers can expect severe difficulty in finding new employment. Compounding the problems are the common insensitivities practiced during downsizing and layoffs.

Furthermore, the impersonal aspects of organizational structure enable and abet dominant supervisors, preventing employees from expressing injustice, frustration and anger.

Toxic companies are controlled through a culture of suppression and fear, creating an environment where mistreatment at the hands of supervisors or coworkers is a daily occurrence. Such environments enhance the potential for anger and aggression for people with low self-esteem and emotional difficulties.

PROFILE OF THE EXPLOSION

Violence directed at employers almost always follows a set sequence. It begins with a traumatic experience, such as a job termination, or a series of minor events such as reprisals and negative performance reviews or the imminent threat of suspension or firing. This, in turn, creates the perception of an unavoidable threat to self. Intense and chronic emotional tension or anxiety follows.

The traumatized employee, rather than acknowledging self-deficits or shortcomings, then projects responsibility for the situation onto others, externalizing blame. The person’s thinking turns inward and becomes increasingly egocentric. Self-protection and self-preservation become the only concerns. From this perspective, violence seems to be the only way out. Following a period of internal conflict, which may be prolonged, the person attempts to commit a violent act.

The typical profile of a violence-prone employee is that of a male armed-forces veteran who has a quick temper on a short fuse. He suffers from low self-esteem, paranoia or depression and is a loner who resents authority. He blames co-workers, management or other third parties for any problem that arises. There is often drug or alcohol abuse, a record of criminal assault or a fascination with weapons. The likelihood of instigating violence accelerates in the face of unresolved conflict and frustration at home or at work.

STEPs TOWARD A SOLUTION

Workers are not commodities nor are they pawns. Their feelings must be acknowledged and they should receive the same personal consideration as do executives and supervisory staff. Despite increasingly economic pressures, all businesses and institutions should treat employees with dignity and respect. As part of this policy, employers should maintain and encourage open communication with a “no consequences” policy that encourages people to say what is on their minds without fear of reprisal.

For their part, managers and supervisors should be alert for potential situational and behavioral problems, particularly when screening job candidates. Co-workers are usually the first to recognize that something is wrong but are often hesitant to get involved or do not see actions taken when they report their concerns.

Employers should create and enforce a “zero tolerance” workplace violence policy, one that prohibits harassment of any kind, threats of violence, intimidation and weapon possession on company premises, and one that elicits quick and appropriate response when any maladaptive behavior first emerges. Managers should take practical steps, which include the creation of special forms and reporting mechanisms for violent incidents, as well as the establishment of a hotline and a confidential procedure for disparaged and titled employees alike that permits timely reporting of threats, belligerence and other inappropriate conduct.

Employers should also assess the security of buildings, which include good lighting and one primary entryway/exit as examples of a well-planned environment that can deter acts of violence.

Although employers should not hesitate to discharge violent workers, managerial personnel should exercise common sense in every situation. For example, one should never fire employees on Fridays or at the beginning of holidays. Better to release employees so they can at least talk (however briefly) with managers or co-workers, obtain more information or start a job search. Again, the rule of respect applies.

Death or injury should not occur in the workplace nor should workplace violence become as commonplace in our society that it is accepted as a cost of doing business. But it will remain unless those whose job it is to create and maintain employment make profound and lasting changes in attitudes and procedures.

Mable Smith-Pittman is an attorney and associate professor of nursing at Old Dominion.
HEART OF THE MATTER

For nearly two generations the twin images of billowing mushroom clouds and fierce, life-shredding firestorms haunted the imaginations of anyone willing to believe the Cold War could abruptly flash to incandescence. The power of the atom had been unleashed and no planetary thing, animate or inanimate, was safe.

Roughly 50 years passed. Despite its association with weapons of mass destruction, physics remained in a kind of golden age. Flush with Cold War money funneled to basic and applied research, physicists were called upon to handle everything from geopolitical defense to rocket science. The investment paid off in an array of products that either were used by or to benefit taxpayers: medical and industrial lasers, microwave ovens, energy-efficient refrigerators, personal computers and compact and digital video discs. So what if dreams of clean, meterless nuclear energy and fleets of atomic cars, planes and spacecraft didn’t quite pan out? Physics had done its job well and nobly.

As the millennium closes, physics finds that it must fight for resources in an era of perceived diminished risk of world war and of tight money. Increasingly, physics must explain itself. Why is it important to know more about the atom and its structure? The articles that follow offer perspective. They demonstrate that from the very smallest of things — from particles so minuscule that detecting their presence is a major technological feat — can come large, unexpected surprise. In physics, in our era, one war may be over but the frontiers remain: remote, strange, exciting, awaiting a more complete cartography.
Imagining a world where no one has yet landed on the moon. The space program doesn’t exist, except in the dreams of a visionary few. The transistor, the integrated circuit, and the ubiquitous computer chip have yet to be invented. There is no such thing as a compact disc player because there are no lasers. Missing are entire fields of knowledge such as modern chemistry, materials science, nuclear science and molecular biology.

Worried about your health? You can forget about going to your physician for advanced diagnostic tests with X-ray devices, CAT and PET scanners, or a magnetic resonance image (MRI), for they are nonexistent to be found; nor is there any radiation-emitting equipment to treat cancer. Your diet isn’t very good, either, thanks no way to transport fresh vegetables and fruit long distances because there aren’t any jet airplanes or automobiles or trucks equipped with internal combustion engines. Which probably doesn’t matter anyway, since without refrigeration you wouldn’t be able to keep perishable foods fresh.

That’s the kind of world we would live in — in fact, didn’t live in — until after the foundations of modern physical science were laid by physicists such as Isaac Newton, who invented calculus and mechanics in the 17th century; James Clerk Maxwell, who created the theory of electricity and magnetism in the 19th century; and Ludwig Boltzmann, whose statistical mechanics brought deep understanding to the thermodynamics developed by other physicists during the 19th century.

Our own century has experienced the twin revolutions of relativity theory and quantum mechanics, which have forever altered our basic concepts of space and time and the structure of matter. The former enjoys great name recognition through its association with Albert Einstein, known to many because of the famous equation E=mc². Quantum mechanics, which had its origins in Max Planck and Niels Bohr in the late 19th and early 20th centuries and matured with the work of Erwin Schrödinger, Werner Heisenberg and Paul Dirac during the 1930s, is less well known to the public. But none of the electronic devices that are essential to modern life, or for that matter, any of modern science that depends on knowledge of atoms and molecules would exist without physics research and physics theory.

Of course, it is misleading to suggest that thermodynamics made the internal combustion engine inevitable or that the development of quantum mechanics made integrated circuits a foregone conclusion. We might have learned all the quantum mechanics we could have ever wanted to know but still never have recognized the possibility of applying that knowledge to invent a transistor or a microprocessor. Certainly, failure to recognize that possibility would have denied us the economic and social benefits of whole new technologies and deprived science of tools and instruments that have made it possible, in turn, to dig even deeper into fundamental questions that would otherwise have been inaccessible to experiment. Lasers and computers provide two excellent examples of this kind.

It therefore seems clear that when we ask the old “chicken-and-egg” question about basic science versus engineering and technology, the answer is that sometimes one comes first, sometimes the other, but they are surely joined at the hip.

A New Golden Age

Developments in physics in the realms of the very large and the very small are continuing in our own time at a rapid pace, and their ultimate influence on our way of life can only be imagined. This truly is the golden age of astrophysics: the new knowledge gained will profoundly affect our understanding of basic physical law and our sense of place in the universe. In the realm of the very small, advances in atomic, molecular and condensed-matter physics are leading to new materials and fabrication techniques that will make much of our present-day capabilities seem crude by comparison.

Imagine going to the hardware store for a spool of wire and being able to choose whether you want “regular” or “superconducting.”

Indeed, research in nuclear physics being conducted here at Old Dominion in partnership with nearby Jefferson Laboratory is in the vanguard of these recent developments, as several of the articles in this issue of Quest indicate. An important new kind of laser known as a free-electron laser, for example, has just started operation at the lab, with unique capabilities for use in both basic and applied areas of research.

At an even smaller level, we have learned that protons and neutrons — previously thought to be the smallest components of atomic nuclei — are ultimately composed of particles called quarks and gluons and that, as a result, our understanding of nuclear physics is still in its infancy.

One might venture that understanding the inner workings of nuclei, in terms of the elementary particles that comprise them might eventually lead to a “chemistry” for the nucleus, just as ordinary chemistry is now understood in terms of electrons outside nuclei. Although the specific benefits of this nuclear chemistry might be hard to predict in detail, it would have been equally hard to predict modern chemistry and all the benefits that flow from it on the basis of Niels Bohr’s first successful model of the hydrogen atom earlier this century.

Dangers of Leadership Lost

Unfortunately the policy consensus in Congress that has supported research in physics and other basic physical science has seriously eroded since the end of the Cold War. With the perceived elimination of that threat has come a desire to concentrate more heavily on finding solutions of relativity theory and quantum mechanics, as well as other scientists face is to inform our fellow citizens and representatives of the many threads that are woven into the fabric of scientific progress; to become spokesmen not just for “my” science but for all of science. I strongly believe that a public properly informed about the need for all the sciences will support a balanced program of research. That job, necessarily, must be the responsibility of the scientific community.

On the economic side, the ability of our country to retain leadership in the new global economy will increasingly depend on highly sophisticated products rather than commodity items. This, too, will be sustainable only in concert with scientific leadership in the fundamental sciences, a leadership that will be extremely difficult to recaputre if ever lost. The danger, then, is that citizens and their representatives will come to believe that basic science is a luxury without realizing just how it is intimately connected to the solution of the real-life, practical problems all of us care about so directly.

The challenge that physicists and, indeed, all scientists face is to inform our fellow citizens and representatives of the many threads that are woven into the fabric of scientific progress to become spokesmen not just for “my” science but for all of science. I strongly believe that a public properly informed about the need for all the sciences will support a balanced program of research. That job, necessarily, must be the responsibility of the scientific community.

James Cox is a professor of physics and chair of the Department of Physics at Old Dominion.
Seldom seen, difficult to capture and tamed only with effort, a strangemenagerie of subatomic particles warms among us in ceaseless flux. All that we know — our bodies, the ground under our feet, the stars over our heads, the air we breathe, the food we eat — is quite literally made from the constituents of the sub-micron atomic realm. We are familiar with some of its inhabitants: the protons and neutrons that comprise the atomic nucleus, and the electron, carrier of the force known as electromagnetism.

Beyond this familiar trio, physicists have identified a set of fundamental building blocks known as quarks. The word “quark” was coined by Irish writer James Joyce in his 1939 novel *Finnegans Wake*; by the late 1960s it had been appropriated by physics to describe six kinds of basic particles believed to assemble in various combinations to form several hundred kinds of more complex particles. For a number of Old Dominion physicists, the mysterious ways and habits of quarks have made for a lifetime work — work that recently has acquired a welcome boost from the maturation of a one-of-a-kind nuclear physics research center.

Old Dominion has been one of the key participants in the development of the Thomas Jefferson National Accelerator Facility, or Jefferson Laboratory, home to the world’s first large-scale, superconducting electron accelerator, a complex assembly of high-tech hardware and electronics stretching through an underground tunnel almost a mile in circumference.

“Jefferson Laboratory is located nearby. It’s not in Blacksburg or Minneapolis,” says Old Dominion President James Koch. “It’s a natural thing for us to look for comparative advantage in our own neighborhood. Jefferson Lab provides us with a superb opportunity to capitalize on our assets.”

### From the Beginning

Old Dominion’s involvement with the Laboratory dates back to the facility’s creation in 1976. The Laboratory was envisioned by physicists as a sort of ultra-microscope, capable of peering deep into the heart of atomic nuclei to answer emerging questions about the nature and role of quarks in matter’s basic structure. Thus it was that a consortium of universities that included Old Dominion — a group formally known as the Southeastern Universities Research Association or SURA, now numbering 49 members and charged with the daily operation of the facility — made a proposal in the early 1980s for construction of a center for nuclear physics research.

In 1983, SURA’s proposal was chosen by the Department of Energy after competition with the Massachusetts Institute of Technology, the University of Illinois, Argonne National Laboratory and the National Bureau of Standards. A year later, 200 acres in Newport News had been selected as the site for the new Laboratory, and initial federal funding had been received for research, development and design. Ten years would pass before researchers would conduct their first physics experiments.

Today, however, basic and applied research are booming at the $600 million facility, as hundreds of scientists around the country and the world journey to Newport News to join the Laboratory’s permanent staff of 500. Experiments that previously took decades or years, or weren’t possible at all, are being done in months at the facility. And spinoffs from the Lab’s unique accelerator and particle-detection equipment are finding their way into the private sector. “Physics is often described as the queen of the sciences. Every other science seems to start with it or depend on it,” says University President Koch. “I think physics is often described as the queen of the sciences. Every other science seems to start with it or depend on it.”

One recent study ranking physics groups placed Old Dominion in the top quarter nationally. The results come as no surprise to Physics Chair James Cox. “The quality of our [physical] group was good, or better than any group in the world,” he contends. “You have to be competitive on the world stage. I think we’ve stepped onto the world stage in a big way.”

At the Laboratory, students and faculty alike have the opportunity to work with state-of-the-art equipment unlike almost any other. The Jefferson accelerator is a research tool designed not to smash atoms but to dissect them. Experimenters accelerate thin beams of electrons to collide with small targets, whilehouse-sized arrays of electronic data-gathering equipment track, measure and record the resultant, telltale data. The electron beam can be split for use by three simultaneous experiments in circular, domed and stations known as Halls A, B and C. By studying the speed, direction and energy of scattered particles, scientists will learn more about how the nucleus is put together.

In pursuit of the Laboratory’s basic nuclear physics mandate, a number of new technologies have been and continue to be developed with the potential for industrial application. These include the creation of a “free electron” laser, a number of accelerator-related technologies; advanced control-system software and next-generation medical diagnostic systems based on Jefferson’s sophisticated particle-detection and data-acquisition systems.

In 1998 Laboratory technology transfer continued its expansion with the move of 200 staff members to the Applied Research Center, a new $18 million, seven-story, 322,000-square-foot complex adjacent to Laboratory grounds. Old Dominion is a primary tenant in that complex, which is aiming to attract applied-physics-related industry and new-business development to southeastern Virginia in the first decade of the coming century. “Jefferson Lab has already been an important investment for the University,” Cox says. “It’s something that’s continuing for years, decades even.”

**By James Schultz**

**By James Schultz**

**Thomas Jefferson National Accelerator Facility**
At Research Center, A Matter of Light Intensified

By James Schultz

Human eyes are easily drawn to a brightening sky at dawn, a reddening sunset or the cold luminescence of a full moon. Sight comes because the human retina perceives the constant splash of the light-energy-carrying particles known as photons. Normally those photons radiate out widely, in different directions and at different wavelengths. Make light march in lockstep, however, and a unique kind of phenomenon occurs: light amplification by stimulated emission of radiation. Thus it is that a device known as the laser produces concentrated, intensely focused light energy.

Lasers are invisible as they are powerful, used in everything from surgery to telecommunications to manufacturing. Medical lasers can pierce the human eye without damaging vision, and industrial lasers can slice through thick metal. Lasers are used in the production of microelectronics and in the collection and analysis of scientific data. By reading the depressions and protrusions on the surface of a compact disk, lasers produce sharp images and crystal-clear sound. Lasers may one day open new power interplanetary spaceships.

Lasers will soon add another accomplishment to the long list of innovations. A new breed of laser derived from basic research in nuclear physics at Thomas Jefferson National Accelerator Facility, or Jefferson Lab, could revolutionize the way goods such as textiles, computer components, solar-power equipment, auto parts and airplanes are designed and manufactured.

The Laboratory’s “free-electron” laser, or FEL, makes use of individual electrons stripped from a source material. The electrons are injected into a linear arm of a racetrack-like oval, where they are steered and accelerated. By the time the electrons reach a device known as a “wigglar,” they are highly energetic. Inside the wigglar, the electrons move up and down, a portion produce photons that are subsequently released as laser light.

Because FEL light can change the surface properties of textiles, the manufacturing industry could eliminate some of the environmentally hazardous, wet-chemical treatments now used during production. The FEL also has the potential to substantially reduce the cost of solar-energy panels by boosting their light-gathering capacity. A host of other FEL applications are possible, including dramatic improvements to the quality and costs of food packaging, food wrap, air and water filters and certain kinds of medical supplies. An FEL could “micromachine” such parts as fuel injectors and ink-jet printer heads, boost material resistance to corrosion and produce a stainless-steel finish on the surface of low-grade steels.

“I have deliberately focused the University’s attention on areas that I feel have the most promise,” says Old Dominion University President James Koch. “I feel the FEL is one of those. I really think this laser will make a commercial difference in the marketplace.”

Future Solutions Today

The FEL is one of the keystone technologies connected with the development of the Applied Research Center (ARC), an $18 million, seven-story, 122,000-square-foot research complex adjacent to the grounds of Jefferson Lab. ARC design and construction costs were underwritten by the city of Newport News, with financial support for research programs, faculty salaries and equipment purchases coming from the state of Virginia.

Major equipment donations have been made to the Center by Xerox Corp. and Eastman Kodak Co.

Old Dominion is one of four university tenants at ARC, which concentrates faculty expertise on solving technological problems of interest to industry. Within the facility, Old Dominion has established a dean’s laboratory that specializes in various aspects of FEL-connected materials processing, as well as in the development of miniature optical sensors and diagnostic apparatus relating to manufacturing and manufacturing quality control. The University is working on projects commissioned by or involving such companies or corporations as Eastman Kodak, Xerox, Solarex, Mitsubishi Chemicals, Siemens and Motorola.

“Our aim is to have a strong economic impact in the high-tech arena,” says Mool Gupta, Applied Research Center director for Old Dominion. “That includes microelectronics, optoelectronics, materials science and engineering. We’re applying University-based expertise to help industry solve problems and to develop applications they may not even be aware of.”

Gupta says that the University’s Research Center participation is particularly beneficial for students, since early and repeated interaction with industry is excellent preparation for future employment. In addition, faculty will be able to pursue important, challenging projects that could benefit the whole of society. Industrial projects also provide an ongoing source of financial support to Old Dominion, as well as the potential for development of Center-derived intellectual property—which, in turn, could lead to whole new industries and many new jobs.

The ARC is the hope for impetus to another ambitious project: a planned research park that designers believe may create more than 4,000 new jobs and attract investments of at least $300 million in property and equipment in the first years of the coming century. Meanwhile, high-tech businesses are being recruited to fill the roughly 20 percent of ARC’s square footage not already occupied by the quartet of universities or Jefferson Laboratory personnel. As the research park matures, more firms are expected to set up shop in or near the Research Center.

“There was an era when one person could work in a lab, alone,” Gupta points out. “Now the complexity is so great that you need a multidisciplinary team. Those who have succeeded, both in terms of funding and in terms of product development, have put together a strong team.”

Working Together

While each of the four state universities housed in the ARC — joining Old Dominion are the College of William and Mary and Christopher Newport and Norfolk State Universities — will conduct individual research ventures, there will be several collaborative areas of focus. In particular, the universities will support the Common Materials Laboratory, a general-purpose facility that will study the specific effects of the FEL on a variety of materials. The Laboratory will house equipment — donated by such Fortune 500 contributors as IBM and DuPont and, in the public sector, NASA, Jefferson Lab and the universities themselves — that will be used communally by all four institutions.

Another shared research area set aside within the Research Center will be known as the Common Laser Laboratory. Here, a number of conventional and low-power lasers will be made available for research and training. A key advantage of university cooperation within ARC is the instruction of students and technicians in the use of current and advanced lasers. Those trained in the Laser Laboratory could go on to positions with existing or new FEL-related companies in the ARC research park, or elect to continue their studies at Jefferson Lab itself.

University-based scientific and technological support for the Jefferson Lab’s FEL Program were guaranteed to intensify and expand. Eventually, other FELs could be built near the site of the original prototype, attracting primary businesses and their suppliers. A relatively large pool of university-trained ARC scientists and technicians will eventually be available to area firms for expansion of product lines and enlargement of the local labor force.

“We wrote a brochure a few years ago. In it we stated that Old Dominion was not built with ivory towers in mind,” says University Provost Jo Ann Gora. “I think that summarizes our attitude toward applied research. That’s why our partnership in the FEL project and with ARC is so important to us.”
I grew up in Belgrade, Yugoslavia, where I didn’t know prejudice of any kind. I was shocked when I discovered the concept even existed. There was no pressure to be or not be something. I felt free to develop my mind. No one told me that physics wasn’t right for a woman. It was not an unusual choice for a woman to make.

Math was intriguing to me, but only if it was employed in something like physics. I was most attracted to its applied side. Otherwise, I felt it would have been an exercise in futility.

What physics answers is how everything works, not why nature works. God will answer that. But if you understand nature you can apply your knowledge to making many useful things. Physics has been applied, from medical lasers to diagnostics. All are based on physical principles.

Good physics research requires a lot of supporting activities — a good machine shop, secretarial service. Everybody has to do their job so I can do mine. Every good result . . . It brings you tremendous happiness. You understand something that you, or somebody else, has never understood before.

Physics often stays within its own community. That’s not enough. Physics must be transferred in some way to the wider community. It’s important to persuadethe general public that physics is useful. Physics and technology and help everyone improve their lives. That’s why it’s important to support fundamental research in physics.

I was always interested in science and the human race’s ability to understand the world in the most general sense. We can turn our ideas into technology, into practical applications. But I’ve always been more interested in ideas. I’m more of an abstract kind of person.

California, where I grew up, was strongly influenced by the fact that my father was a nuclear chemist ... I can . . . discipline in which we tie equations to the real world. We look at a piece of reality and it has consequences.

Nobel laureate Leon Lederman has estimated that 30 percent of our gross domestic product is directly due to our theoretical understanding of quantum mechanics. Again, physics often stays within its own community. Look at computers. They’ve gotten faster and faster and cheaper and cheaper. Our ability to do this is entirely due to our understanding of the physical properties happening inside the silicon from which we build microchips. The silicon is in 20 years, as we go even smaller. When you go from microns to nanometers, the internal structure of a computer changes radically.

And you have to understand how fundamentally it works — and so, physics.

There’s no lack of ideas in physics, no lack of new technology. In physics we’re constantly finding new phenomena. The end is not in sight.

Charles Hyde-Wright

Leposava Vukovic

Desmond Cook

Mark Havey

I was born in Australia, in the town of Geelong, which is 45 miles southwest of Melbourne. It was a combination rural and industrial area and one of the main shipping ports in the south. Geelong is still famous for its textiles, but you drive 5 or 10 miles and you’ll be in a sheep-farming and dairy area. Because I was an only child I had to amuse myself. So I read books general science, medical-type things. Math was very interesting to me.

My father was a chemical engineer who was killed when I was quite small. My mother and I lived with my mother’s parents. When I was 9 or 10 my mother bought me a chemistry set and I started making models, building things like small plastic cars, jets and the like. Playing with different kinds of instruments — electronics, mechanical things — always really fascinated me. I also loved to paint and do woodwork with my grandfather’s tools. By the time I was in high school, I took a keen interest in physics. I think it was the experimenting and the hands on learning. I don’t know why, but there were about 10 of us who really wanted to go to university to study physics. We batted each other and it forced us to improve. In this country up to $600 billion is spent annually maintaining and replacing corroding materials. That’s a significant amount of money, about $3,500 per person per year. Bringing my background in physics to address what really is an engineering problem. I basically want to improve the quality of steels. My specialty is the field of corrosion — more particularly the process and the byproducts of corrosion. What exactly happens when a piece of steel rusts or corrodes? What products form? I deliver to the microscopic interactions, which need to be studied at the atomic level.

I made up my mind years ago I would concentrate my research in areas of industrial interest and which were beneficial to society. My goal is to help make bridges and buildings last longer. The longer-term goal is to improve materials overall. That helps everyone.

I was part of a large family in rural Maine. There were six of us — three brothers, two sisters and myself. All of us worked toward our aspirations. My father was a nuts-and-bolts biologist. He would bring home whole fish and put them in the freezer. The whole house smelled of fish all the time . . . I went to an engineering school and majored in engineering physics. I didn’t think I was cut out for . . . I was interested in astrophysics. I discovered I was pretty good in physics in general, better than I had supposed . . . As it goes along, physics spawns new technologies. One of its main benefits is the treasures it dumps out along the sides as it goes along on its quest. In physics I was trying to look for understanding of the world in a deeper way. I am constant with what I’ve found: an intellectually challenging career, an explanation of the things going on in the world and an appreciation of randomness. But the most interesting, the most fulfilling thing has been teaching students how to do experiments.

You go where the experiment tells you to go. You see what your results are telling you. Sometimes the results are fairly ordinary. Other times you find mysteries. It’s the mysteries — the things you don’t understand — that are the most important. They lead to a deeper understanding of existing physics or entirely new directions in physics. What you expect to do is introduce a new idea or discover something that no one has ever seen before.
Tomorrow’s Prosperity Today?

By James Schultz

It may be among the oldest questions asked by humanity. What will happen tomorrow? Those who know tomorrow’s secrets stand to benefit today — not to mention every day following. To slake individual thirst for accurate prediction, seers and prophets, sincere and profit-mongering alike, have long sought to get the future right.

None of the trio of Old Dominion economists behind the Economic Development Alliance Forecasting Project professes to read the road ahead with 100 percent...
balancing the negative trends. In the northern portion of the region, in particular near the cities of Hampton and Newport News, there has been a net increase in technology employment and a small net gain in defense-related jobs despite the cuts. The modellers say Hampton Roads residents can take comfort in the fact that the local economy remains resilient despite its weakness relative to strong growth rates in the suburbs outside Washington, D.C., in northern Virginia. "We know the facts. In terms of its gross regional product, Hampton Roads has slipped in relation to other parts of the state," ventures team leader Yochum. "But the regional economy is also experiencing much lower unemployment rates. That's a very good sign. There will be more pressure on wages and salaries as a result. People are better off, and they'll pump more money back into the Hampton Roads economy."

Improvements to the forecasting model to improve its accuracy will continue to be made. Its predictive value should increase, say the forecasters. Says Yochum: "This model is a product of science. Part of the fun of this is learning more about it and learning how to make it better."

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