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From Wood To Paper

The world's increasing hunger for paper is fed by a process invented some 2,000 years ago

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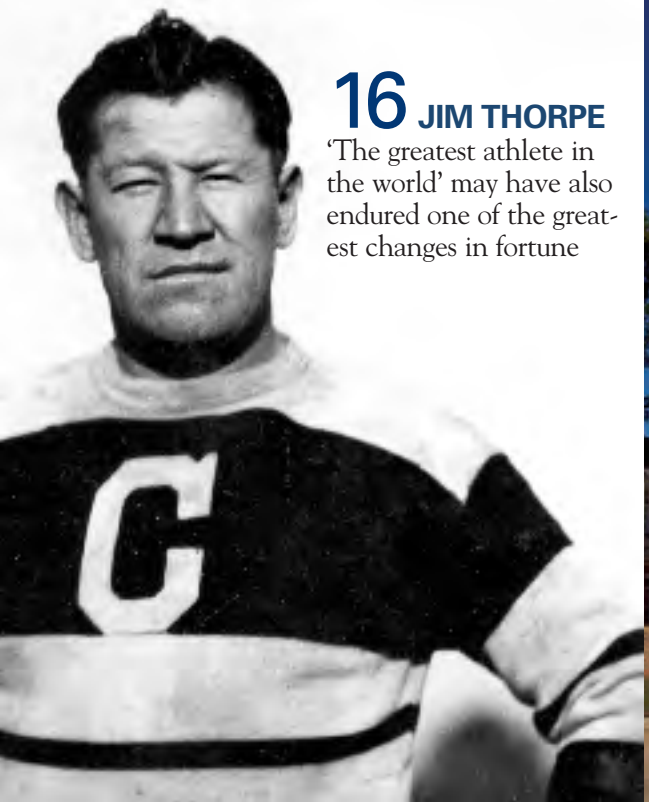

The Demand for Power

Have you ever stopped to consider how often you use paper products throughout the day? Newspapers, tissues, paper towels, reports, magazines, bills, boxes, copier paper … the list is seemingly endless! This quarter's feature article is about the paper industry. The preparations for this article made us take a hard look at how we use, and perhaps misuse, this ubiquitous product.

Dixon has used recycle bins, separated office paper and recycled cardboard for years, but it still seems that we use too much. An internal team studied usage and reported that although much of the information we need is available electronically, we still print reports. Their recommendation was that we work harder to move to a paperless process whenever possible. One thing is certain: the issue is not going away.

Despite the advent and popularity of the Internet and electronic media, worldwide paper usage is still growing quickly. Will we be able to keep up with the demand? Something to think about as you go through your day. If we all work toward conserving in our individual lives perhaps globally it won't seem like such a daunting task.

Enjoy Boss, and as always, we encourage your comments!

Dick Goodall

Thank you to all who sent images for the BOSS photo contest. This photo of a Virginia paper mill, which complements our feature story about how paper is made, was submitted by an anonymous BOSS reader. BOSS magazine will occasionally print photos of industrial subjects submitted by readers. Photos can be sent at any time to BOSS@dixonvalve.com or to BOSS Photos, Alter Communications, 1040 Park Ave., Suite 200, Baltimore, MD 21201. (By submitting photos, the owner gives Dixon Valve & Coupling Company the rights for unlimited use.)

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The True Meaning of Our Lives

By Michael Josephson

I saw a cartoon of an old king checking in at the gates of heaven. The gatekeeper, with a large book in front of him, said, "Edward the Good, huh? Well, Eddie, we will be the judge of that." The point is that, in the end, generous self-appraisals won't matter. Our epitaphs will be written and eulogies delivered by the people who knew how we lived. The real meaning of our lives may be defined by how we are remembered.

When a Swedish newspaper printed Alfred Nobel's obituary by mistake, he had the rare opportunity to see how others saw him. It changed his life dramatically. Though the article was complimentary, describing Mr. Nobel as a brilliant chemist who made a great fortune as the inventor of dynamite, he was horrified to be memorialized in such materialistic terms. Determined to leave a more positive legacy, he bequeathed his considerable wealth to the establishment of the Nobel Prizes to acknowledge great human achievements. Few of us can create something as momentous as the Nobel Prizes, but we can all live lives that earn a eulogy our children and parents would be proud of.

In the hurly-burly of everyday living, it's hard to keep perspective. Money, position, pride and power seem so important—until they're not. At the end of their lives, no one says, "I wish I spent more time at the office." It's a matter of priorities.

So, if you want to know how to live your life, just think about what you want people to say about you after you die—and live backward.

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His Finest Hour

Winston Churchill championed the civilized world when it counted most

By Lisa De Nike

IMAGES COURTESY OF THE LIBRARY OF CONGRESS

Winston Churchill's courageous and visionary leadership as prime minister of England during World War II guided the Allies to victory against fascism and terror. Indeed, historians agree that without Churchill's guidance, the world would be very different today.

Those who knew Sir Winston Churchill during his childhood and adolescence likely never predicted that the troublesome child afflicted with a speech impediment would someday become one of history's greatest figures. He was born prematurely on Nov. 30, 1874, eight months after the marriage of his parents, Tory politician Lord Randolph Churchill and Jennie Jerome, the beautiful daughter of New York businessman Leonard W. Jerome.

Churchill did poorly in the early years of his schooling, but despite early challenges, he eventually excelled in the study of history and English and became the Harrow School's fencing champion before graduating in 1893 and entering the Royal Military College at Sandhurst.

Upon graduation, he entered the British army as a cavalry officer. Over the next few years, he saw action in three campaigns: the North-West Frontier campaign in India in 1897 and Spanish-Cuban conflict and Sudan campaign in 1898. This is also when Churchill began what would become an illustrious, lifelong career as a writer and wordsmith, serving as a war correspondent for a number of London newspapers.

His writing career began with reports from his time as a soldier at war and eventually included a novel, two biographies, as well as a four-volume history of World War I and a set of memoirs from World War II. In addition, after he retired, Churchill wrote a *History of the English-Speaking Peoples* in four volumes, and his lectures have survived in *The Dawn of Liberation*, *The Unrelenting Struggle*, *Victory* and dozens of other volumes.

In 1953, his historical writings won him literature's top honor: a Nobel Prize. The committee wrote that Churchill was being honored "for his mastery of historical and biographical description as well as for brilliant oratory in defending exalted human values."

Many historians, in fact, contend that it was Churchill's love of words—cultivated as he stood in front of a mirror and battled speech problems in the early years—that catapulted him onto the world stage years later. This love manifested itself in speeches (including his famous "We Shall Fight on the Beaches" and "This Was Their Finest Hour" addresses, both given before the House of Commons in June 1940) that are considered masterpieces of oratory. (The full text of his most famous speaches can be found at *www.winstonchurchill.org*.)

Churchill's career in politics began in 1901 when he entered Parliament at the age of 26. Nine years later, he became home secretary (the country's top security official) and a year after that, first lord of the admiralty, a position that gave him responsibility for the command of the royal navy.

Though he was credited with encouraging the development of naval aviation and of tanks, he also was blamed for what historians considered "a heroic failure": the 1915 deployment of the British navy and army to the Mediterranean to outflank the Germans at the Gallipoli Peninsula in Turkey. Though initial attacks were successful, the Turks proved to be fiercer enemies than Churchill had anticipated. On March 18, 1915, three British battleships were sunk and three more

In 1921, Winston Churchill was sent to the Middle East as colonial secretary, charged with making a new and more just settlement after World War I. Here he stands with T.E. Lawrence (Lawrence of Arabia) and the Emir Abdullah of Transjordan (later king of Jordan).

were crippled. Overall, the campaign was a disaster, with more than 200,000 Allied casualties. As a result, Churchill resigned in disgrace.

Though Churchill did occupy several other governmental positions between World War I and World War II, his real return to prominence began on September 3, 1939, the day that Britain declared war on Germany and the day that Prime Minister Lord Neville Chamberlain again appointed Churchill first lord of the admiralty and a member of the war cabinet. Historians assert that the force of Churchill's strong personality and original ideas began immediately to resonate throughout the Chamberlain administration.

Indeed, as far back as the mid-1930s, it was Churchill who had loudly declared that Adolf Hitler posed a serious threat to world peace, and that no government should make deals with the Third Reich and its despots.

So when Chamberlain (who did broker deals with the Nazis) lost the confidence of his people in 1940, Churchill became the obvious replacement. He inherited a perilous situation, with France soundly defeated and England under constant German air attack.

Still, Churchill stood strong. Instead of accepting Hitler's offer of peace in exchange for surrender, Churchill organized the successful air defense that led to victory at the Battle of Britain. Many say that America's entry into World War II marked the culmination of Churchill's leadership, with the prime minister undoubtedly exalting in the success of the D-Day invasion in 1944.

Though there is no doubt that Churchill's unwavering leadership and inspiring words held his country—indeed, the civilized world—together against its common enemy during World War II, he lost the 1945 general election to the Labor Party's Clement Attlee and retired from public life temporarily. Unable to resist the lure of political life, however, he again resumed the premiership in 1951 and governed for four years. He remained a member of Parliament until 1964, when he did not seek re-election. He died just one year later, at age 90.

Churchill is clearly one of history's great men—a person who found his own "finest hour" during one of modern history's most challenging times.

From Wood To Paper

By Virginia Hughes

The world's increasing hunger for paper is fed by a process invented some 2,000 years ago

A MODERN PAPER MILL is a flurry of movement, noise, heat and steam. On cement-floor highways, forklift drivers navigate through wooden crates and steaming stainless steel pipes, sweating in temperatures that can reach 130 degrees Fahrenheit (about 54 degree Celsius). At the bottom of 10,000-gallon bubbling vats, sharp rotor blades stir chunky, fibrous paste. In a windowed control room, lined with button panels and computer screens, technicians watch the paste as it moves down the line—as fast as one mile per minute—getting thinner and drier and smoother until it emerges, 60 minutes later, in long, uniform rolls.

The world paper industry now produces more than 350 million tons of paper each year, a five-fold increase since the 1960s, for use as copy paper, newspaper, tissue and, less obviously, as filler material inside stereo speakers, electric plugs, even shoe inserts.

Pulp wood, above, is transported by train to a paper mill in Northern Ontario, Canada.

Paper has its beginnings in the forest, and more than half of all forestland is found in Russia, Brazil, Canada, the United States and China. Not surprisingly, these are also the countries that produce the most paper. The United States makes the most paper in the world, by far: 81.4 million tons in 2005, according to the latest data from the Food and Agriculture Organization of the United Nations. In comparison, second-place China made 53.5 million tons. (See sidebar: "Papermaking by the Numbers," page 15.)

Experts predict that in the coming decades, the world's major paper markets will shift. North America's paper production peaked in about 1991, says Joseph Genco, a professor of pulp and paper science and engineering at the University of Maine. "But in the last 10 or 12 years, the capital investment in the industry has been contracting very slowly." He adds that this lack of interest from investors, despite the continued improvements in paper machine technology, "is a fundamental problem. I think we're [the U.S.] becoming less globally competitive."

At the same time, the Eastern markets are on an upswing. "Even though paper was invented in China, the paper industry in that part of the world is relatively young," explains Timo Merikallio, senior vice president of technology at Botnia, a large pulp company in Finland.

Newly booming middle classes in China and Russia, especially, mean that international paper companies are starting to invest heavily in those regions. Experts predict their paper output will surpass North America's by 2015. "As their standard of living increases," Merikallio says, "so will their local consumption of paper."

Papermaking

Though the ancient Egyptians scripted hieroglyphics on thick sheets made from papyrus, historians credit paper's spread and standardization to the Chinese servant Cai Lun, who worked for the Chinese emperors in the early second century A.D. In the years before Cai Lun, the Chinese wrote on silk, bone and bamboo scrolls. But silk was prohibitively expensive, and bone and bamboo were heavy and difficult to transport.

In 105 A.D., Cai Lun presented his process to Emperor He: Mulberry bark, hemp, linen and water are mashed to a pulp. The pulp is poured onto a wood-framed fabric screen that's floating on water. The screen is then lifted so that the water can drain through the fabric, leaving just the long plant fibers on the surface. These fibers, once dried in the sun, could be peeled off the fabric as one extremely thin, ready-to-use sheet of paper.

With the invention of the printing press around 1450, demand for paper skyrocketed and mills appeared all over Europe. More than 200 years later, in 1690, the first mill opened in the New World, in Philadelphia, Pa. And in 1799, a French inventor developed the Fourdrinier machine, which thinned and smoothed the pulp on continuously moving assembly-line belts. A version of the Fourdrinier model is still used in most paper mills today.

Trees

More than 90 percent of the world's paper comes from trees of two types: hardwoods, like maple and oak, and softwoods, like pine and spruce. "The fibers in softwoods are longer and make a stronger sheet of paper," explains Gary Scott, chair of the Paper and Bioprocess Engineering Department at State University of New York, "but most paper has a mixture of the two."

Both types have the same basic anatomy: cellulose fibers glued together with a substance called lignin.

The crux of making paper is extracting the cellulose fibers from the wood and lining them up in the same direction. "The same technology is used globally," Merikallio says. "If you take a Chinese modern paper mill and compare it to a Finnish one, you probably wouldn't be able to tell the difference."

It all begins with harvested tree trunks, which are cut into 4- to 8-foot logs and then run through a debarking machine. Whirling blades in a chipping machine then cut the naked logs into 1-inch chips, which are either pumped through pipes or shipped to a nearby pulp mill.

Wood into Pulp

The purpose of pulping is to free the cellulose fibers from the rest of the wood. Wood is pulped using a highly efficient mechanical technique, a chemical technique, or a combination of the two.

About one-quarter of all pulping worldwide is done with a mechanical process, in which the wood is put into a "refiner" that grinds it between a rotating steel disk and fixed plate. Though this

How Much Paper Comes from One Tree?

The short answer is, it depends—on the tree size, wood density, what process you're using for pulping, and what kind of paper you're making.

In 1992, Tom Soder, a graduate student in the Pulp and Paper Technology program at the University of Maine, calculated that if you wanted to make a ton of printing paper by putting a mixture of hardwoods and softwoods, all 40 feet tall and about 7 inches in diameter, through the kraft pulping process, then you'd need 24 trees.

The Conservatree nonprofit extrapolates from Soder's method some other interesting figures:

- 1 ton of 100 percent virgin (non-recycled) newsprint uses 12 trees.
- 1 ton of coated, higher-end virgin magazine paper (used for magazines like *National Geographic* and many others) uses a little more than 15 trees.
- One tree makes 16.67 reams of copy paper or 8,333.3 sheets.

Paper giant Boise Cascade does its own calculating on its Web site. It states that one cord—a 128-cubic-foot pile of wood—makes 89,870 sheets of letterhead bond paper, or 2,700 copies of a 35-page newspaper.

The paper-making process begins when tree trunks are debarked and then fed into a chipping machine. The resulting wood chips, below, are then transported to a nearby pulp mill.

Wood chips are transformed into pulp, which is then mixed with water in pulpers that hold thousands of gallons (above). If pulp needs to be transported to a distant paper mill, it is dried and cut into rectangular sheets (below).

method ensures high yields—Scott estimates that 80 to 95 percent of the chips that go into the grinder turns into pulp—it doesn't get rid of much lignin, making the final product turn yellow or brown in the sun. Mechanical pulping is used mostly for newsprint or packaging papers.

Much more common is chemical pulping. In the chemical "kraft" process, wood chips are dumped in a vat of sulfuric acid and sodium chemicals, called a digester, and then pressure-cooked to remove about 90 to 95 percent of the lignin. The cooked pulp is then rinsed to remove the excess lignin and chemicals. At this stage, the remaining 5 or 10 percent of lignin in the pulp makes it brown. Chlorine dioxide, lye and ozone, among other chemicals, are added to bleach it into a bright white.

Chemical processes are much less fruitful than mechanical ones, says the University of Maine's Genco. "In a chemical process, you end up dissolving about half the wood solids away," he says. As a consequence, Genco says a lot of research is focused on increasing the yield and on producing other products—like ethanol—from the material that's not made into pulp.

At an integrated paper mill—that is, one that creates both pulp and paper—the bleached pulp feeds directly into a paper machine. At a simple pulp mill, the dried pulp is cut into rectangular sheets, which are stacked and shipped off to a paper mill.

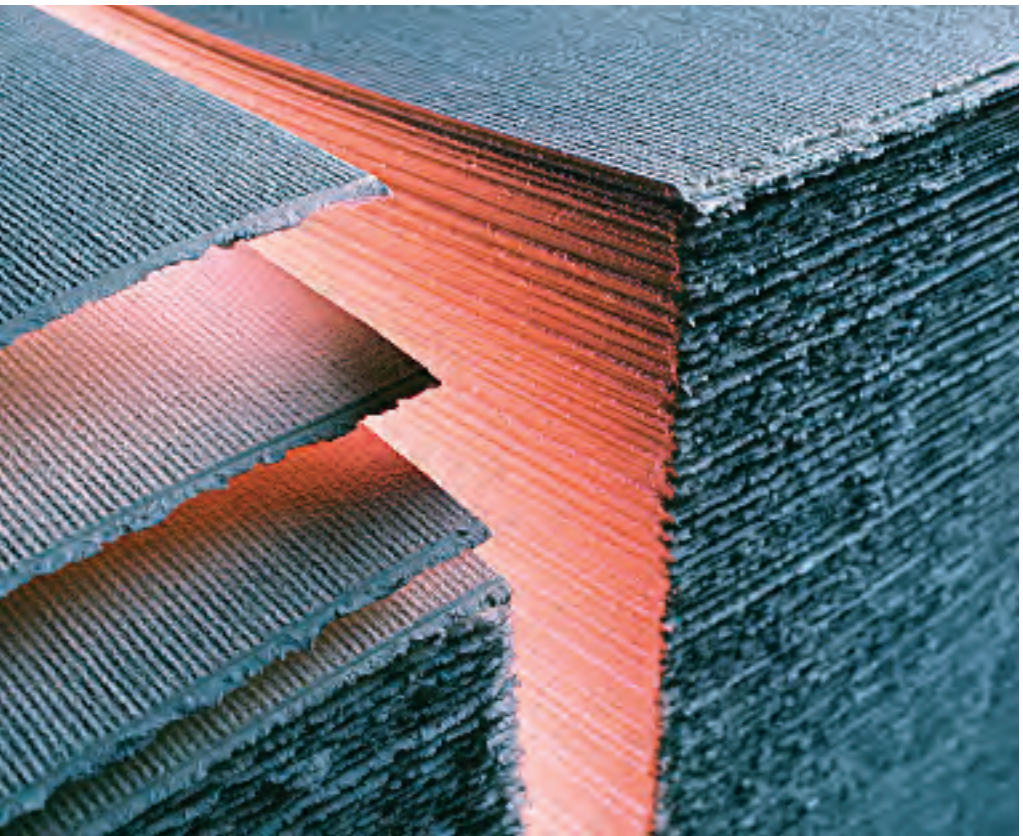
Pulp into Paper

Once delivered to the paper mill, pulp is first broken down in "pulpers" that hold thousands of gallons. These large vessels mix the pulp with up to 100 times its weight in water and then agitate the mixture with steel rotor blades. The slurry is then piped to 1,500-gallon holding tanks where, depending on the type of paper desired, various chemicals may be added. Clay and chalk, for instance, are commonly used to adjust the paper's final opacity. Starches are added to seal some papers, leaving the distinct stench of instant mashed potatoes.

The next stop is the paper machine. Once the pulp enters the machine, it doesn't stop moving until it's rolled up as a finished paper product. The belts move at a jogging pace, from about 575 feet per minute for an average-grade paper to more than 5,000 feet per minute on the fastest machines.

Machines come in all different sizes and work at varying speeds, but their fundamental mechanics are always the same. First, the pulp is watered down even more and pumped into what's called a "head-box." The head-box pushes the 1 to 1,000 pulp-to-water mix out through a horizontal slit and onto a moving belt of wire mesh. Water falls through the holes in the mesh, leaving the fibers aligned in a thin, wet sheet atop the wire.

The wet sheet then gets fed through a series of presses and then through heated iron cylinders for drying. The final paper product, made up of about 5 percent water, is rolled into 12,000-pound,

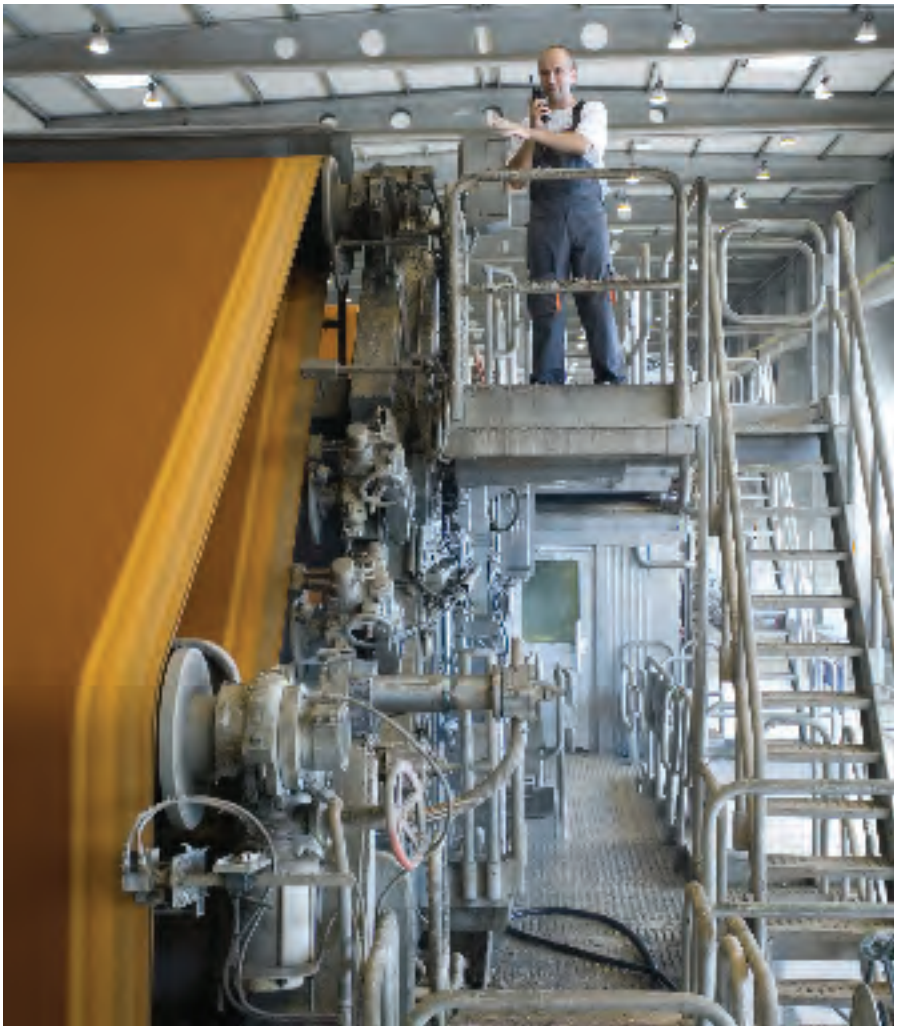


60-inch diameter reels that hold as much as 40,000 feet (12,192 meters) of paper. Most paper mills have machines on-site that cut the paper into rolls of various sizes or reams and then ship them off to their customers. This issue of *BOSS* magazine, for instance, used about 15,000 pounds of paper that arrived from the paper mill in 35-inch-wide rolls.

The fibers contained in new paper can be easily re-pulped and processed to make recycled paper. To recycle paper, the used paper must first be de-inked to remove contaminants such as inks, glues, even staples and paper clips. Once that's done, fiber can be dumped in the digester just as virgin wood chips are. The product, though, won't be exactly the same. The extra processing slightly damages the fibers; each fiber can be recycled three to six times before it loses all strength.

Papermaking's Environmental Footprint

The paper industry has come under fire in recent decades for its environmental footprint. Pulp and paper mills create



Pulp moves at high speed through a paper machine before it is rolled into huge reels ready to be cut and shipped (above).

Biopulping

The conventional chemical pulping process—in which chemicals break down wood to release cellulose fibers from the lignin "glue"—yields only 45 to 50 percent. Moreover, chemical pulping produces toxic byproducts that are released into air and water. Mechanical pulping doesn't use chemicals, but still consumes enormous amounts of energy.

But nature has its own wood decayers, and they're both efficient and clean: fungi. These moldy organisms are at the heart of a third kind of pulping process, called biopulping.

About 20 years ago, scientists looking to develop biopulping methods at the University of Wisconsin's Forest Products Lab screened hundreds of different fungi. "They were looking for one that preferentially attacked the lignin in the wood," says Gary Scott, who worked on the Wisconsin project a bit later and is now chair of the Paper and Bioprocess Engineering Department at State University of New York. The scientists identified one species, *Ceriporiopsis subvermispora*, that broke down both hardwoods and softwoods very well.

Just 5 grams of *C. subvermispora*, when fed the right nutrients, could break down a ton of wood chips. The only drawback: the biological breakdown takes about two weeks, compared to the chemical process that takes three hours.

The Wisconsin team took its bugs to a commercial mill and tested them successfully on 50 tons of woodchips. "But that's as far as it ever went," Scott says.

At that time, "the paper industry went into quite an economic slip," Scott explains, where little excess money was available for capital improvements. "Now we're just starting to come out of it."

But research continues at academic institutions, and now the technology has advanced to the point where biopulping could be scaled up for large mills. "The technology is there, and it's been demonstrated on a large scale," Scott says. "It's just a matter of a company making a capital investment."

As for when it will actually be implemented commercially, Scott estimates five to 10 years, depending mostly on rising energy costs. "As energy prices go up, it just becomes more and more advantageous to use it."

Finished paper is wound onto rolls at a Wisconsin paper mill, left; rolls of newsprint sit ready to be shipped to printing plants, right.

tons of air and water pollution, deplete the world's natural forests and use primarily fossil fuels. Yet, as the world's consumption for paper increases, so does consumer and corporate awareness about the environment—leading the world's top companies to make some smart changes to the process.

Virtually all paper mills use oxygenated chlorines for bleaching, as they produce far fewer toxic byproducts. Some of the worst environmental pollutants have come from pulp bleaching that, before the early 1990s, relied on elemental chlorine.

Critics also have bemoaned the paper industry's negative effect on the world's forests.

Unlike the fossil fuels used to make most of the world's electricity, paper is made from vast numbers of trees, which are renewable resources. However, it takes many years to grow a tree, a rate that's exceeded by the rapidly growing demand for paper. (See sidebar: "How Much Paper Comes from One Tree," page 11.)

Consequently, paper producers are relying more and more on privately owned tree plantations that cultivate only the fastest-growing trees, but to stimulate fast growth, tree farmers use heavy loads of pesticides and fertilizers.

One solution to help maintain forest sustainability and lower pollution is to use more recycled paper. The Worldwatch Institute claims that using recycled material to make paper lowers water pollution by 35 percent and air pollution by 74 percent.

In addition to creating pollution and depleting forests, the paper industry is "a very energy and resource intensive process," says George Milner, senior vice president of energy, environmental and governmental affairs at Mohawk Fine Papers in Albany, N.Y. Indeed, the paper industry is the world's fifth largest industrial energy consumer, and paper mills use more water per ton of product than any other industry.

Because of the recent media focus on climate change and the shrinking oil supply, many consumers are demanding that paper companies consider renewable energy. Since about 2002, Milner says he has noticed "a great deal more awareness among our customers, especially our large institutional customers, about the environmental consequences of papermaking."

One way Mohawk and other paper mills have addressed these consumer concerns is to buy wind-generated electricity credits—basically contributions to wind power farms—from their local power companies to offset the large amounts of carbon-based electricity they use.

Figuring out how to fix these environmental problems is a hugely important task, for paper is the backbone—figuratively and literally—of our traded goods, our money, our entertainment and our history. Even in today's electronic age, most of us couldn't go a day without using paper or paper products, which suggests that China's great invention is likely to stick around for another few millennia.

Dixon in Paper

The following Dixon products are utilized by the pulp and paper industry:

Boss Couplings and Clamps

Cam and Groove Couplers & Adapters

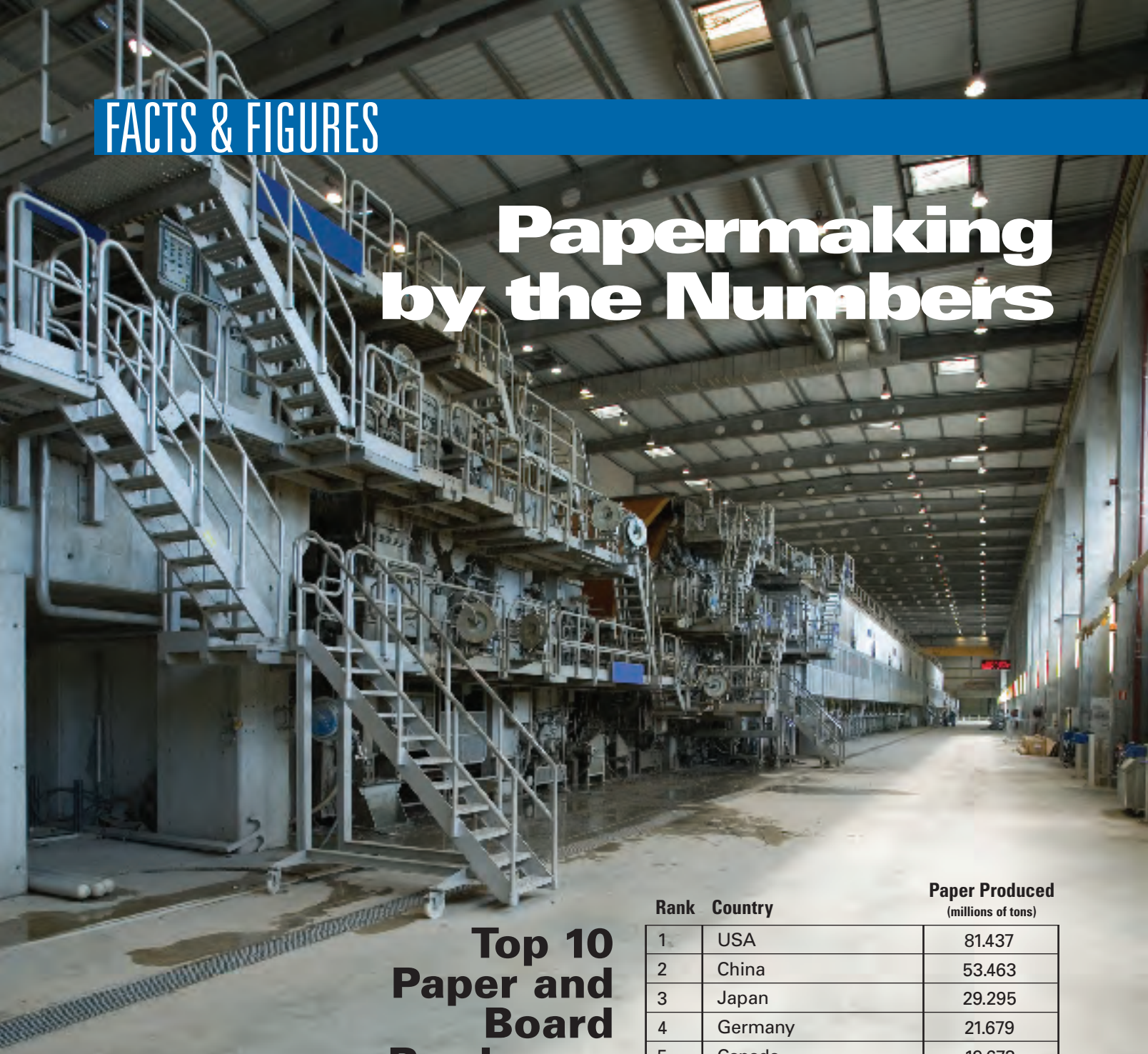
FRLs & Gauges

Black Liquor Ball Joint Armored Hose Assemblies

Contractors Wash Down Nozzles

Mill Hose

Papermaking by the Numbers



Top 10 Paper and Board Producers

(Source: Food and Agriculture Organization of the United Nations, 2005)

Rank	Country	Paper Produced (millions of tons)
1	USA	81.437
2	China	53.463
3	Japan	29.295
4	Germany	21.679
5	Canada	19.673
6	Finland	12.391
7	Sweden	11.736
8	Korea	10.549
9	France	10.332
10	Italy	9.999

World	354.091
European Union	97.570
World Developed Countries	245.136
World Developing Countries	108.955

THE GREATEST ATHLETE IN THE WORLD

OLYMPIAN JIM THORPE WON GAMES AND BROKE RECORDS, BUT WAS DEALT A BLOW FROM WHICH HE NEVER RECOVERED

BY SUE DEPASQUALE

With crowds cheering and flags waving that July afternoon in Stockholm, Sweden, Jim Thorpe basked in the joyful celebration that he would later describe as the proudest moment of his life. "Sir, you are the greatest athlete in the world," King Gustav V said to the muscular young athlete, after he had bestowed upon him Olympic gold medals in the pentathlon and the decathlon. Thorpe, with Panama hat in hand and two laurel wreaths atop his head, replied with characteristic simplicity, "Thanks, King."

The 25-year-old American Indian would leave the 1912 Summer Olympic Games with his two medals—as well as a bronze bust of Gustav and a jewel-encrusted silver chalice from the czar of Russia—and return home to a ticker tape parade in New York City as America's darling. He'd already proven himself a phenom on the collegiate football and baseball fields at the Carlisle Indian Industrial School, and his track and field prowess was legendary. Thorpe's performance at the Olympics, where he set a decathlon world record that would stand for 16 years, was the apex of his career.

As the cameras flashed and the confetti flew that summer of 1912, Jim Thorpe could have no inkling of the wrenching change in fortune that lay just around the corner.

WILD CHILD

Born on the Sac and Fox Indian Reservation to parents of mixed heritage, young Jim Thorpe spent most of his childhood roaming the Oklahoma woodlands surrounding the family cabin with his twin brother, Charlie—and running away from school to his parents' dismay. Both Hiram P. Thorpe, a hell-raising bootlegger with Irish American roots, and Charlotte Vieux, of French and American Indian descent, were literate. Thorpe's parents subscribed to the prevailing belief of the time—that "civilizing" their children meant sending them to boarding school to erase their traditional Indian ways.

Jim hated the strict discipline and tedious curriculum of the mission school they first attended, and he lost his brother and best friend at 9, when Charlie died of pneumonia in the wake of an 1897 typhoid epidemic. At 12, the Thorpes packed Jim off to the Haskell Indian School near Lawrence, Kansas. He ran from there, too, this time to the high plains of Texas, where he spent adventure-packed months breaking wild horses. A bigger and stronger Jim came home from Texas to find that his mother had died. With a new stepmother in residence and two baby half-siblings, the house was noisy and crowded.

So the elder Thorpe sent the 15-year-old even farther afield, this time to the Carlisle Indian Industrial School in Pennsylvania—considered the most prestigious Indian boarding school in the United States. "I want him to go make something of himself, for he cannot do it here," wrote Hiram Thorpe in his application.

The Carlisle school (which operated from 1879 to 1918 and is today the site of the U.S. Army War College) was led by abolitionist Richard Henry Pratt, a progressive whose motto was "Save the man, kill the Indian." He pushed a liberal arts curriculum that included art and music, and encouraged a charismatic young athletic director, known as Glenn "Pop" Warner, to build a tremendously successful sports program that generated a hefty income and put Carlisle on par with the country's best football teams.

Thorpe immediately took to Warner, thanks in no small part to the way the coach indulged his "athletic boys." His Indian players lived in a separate dorm and ate better food, and they received gifts of clothes and pocket money to spend around town.

With his speed, strength and agility, Jim Thorpe took naturally to track and field events (one account had him clearing the 5-foot-9-inch bar of the high jump on a whim, in his street clothes), and before long he was bringing honors to Carlisle in regional meets. Athletic records of the period clock him doing the 100-yard dash in 10 seconds flat—and the mile in an amazing 4:35.

But it was football that he really wanted to play. Warner's football players had made a name for themselves, pioneering the forward pass and showcasing crowd-pleasing tricks like "the hunchback" in a famous game against Harvard in 1903. "They were a very romantic team, the first great trick-play team," notes Sally Jenkins, author of *The Real All Americans: The Team That Changed a Game, a People, a Nation* (2007).

But Warner was not happy to see the 20-year-old Thorpe show up for tryouts in 1907. "Take that uniform off. You're too valuable," he reportedly muttered, when he saw Thorpe standing before him. Hoping to teach him a lesson, Warner served him up as fodder for his tacklers. Run the ball from one end zone to the other, he told Thorpe. And so Thorpe grabbed the

As a running back for the Canton Bulldogs, Thorpe leaps into the fray during a 1915 game against the Columbus Panhandles.

Jim Thorpe throwing the discus during the pentathlon event of the 1912 Olympic Games in Stockholm. He went on to win the pentathlon and decathlon gold medals.

ball and ran, evading some tacklers, throwing off others, zigging and zagging in a magical 100-yard run through the defense that left Warner agape. Do it again, he ordered. And Thorpe obliged. "Sorry, Pop. Nobody is going to tackle Jim," Thorpe said afterward. Warner would later call those runs "an exhibition of athletic talent that I had never before witnessed, nor was I ever to again see anything similar which might compare to it," according to Bill Crawford in *All American: The Rise and Fall of Jim Thorpe* (2005).

Carlisle won 11 football games that season, many of them thanks to Thorpe's formidable punts made in the clutch. He could kick the ball so high and so far, and run so fast, that he could sprint down the field in time to deliver a punishing tackle the moment the receiver grabbed the ball. Thorpe was named third-team All-American in 1908, and second-team All-American in basketball. When he made his pitching debut for Carlisle that spring, he pitched a no-hitter.

That summer, he signed on to play semipro baseball with the Rocky Mount team of the Eastern Carolina League. At $25 a week, the pay wasn't great, but the league drew many less well-off collegiate players who needed to earn money. While most used different names for their summer play, Thorpe didn't. He played a second summer of semipro baseball (after taking a yearlong break from Carlisle) before heeding Pop Warner's entreaties to return to play for Carlisle's 1911 football team, which the athletic director had hyped as a national powerhouse.

In a closely watched game against Harvard that year, the 24-year-old Thorpe played despite a badly sprained ankle, demonstrating a degree of grit and courage that left even the Harvard fans cheering. The press jumped on the story, and Thorpe made headlines across the country.

RISE AND FALL

The media buzz followed him that summer of 1912, when he boarded the *USS Finland* for the Stockholm Olympics with Pop Warner at his side—as his "guardian." Because American Indians were legally restricted from having U.S. citizenship, Thorpe competed for his country as a "ward." He handily won the pentathlon (which included the running broad jump, javelin, discus throws, 200-meter dash and the 1,500-meter race) and the decathlon (those events plus the 100-meter dash, high jump, 100-meter hurdles, shot put and 400-meter run).

Thorpe returned to an adoring public and offers to play pro football and baseball. But just a few months later, in January 1913, the bottom dropped out of Thorpe's world, when an editor for the Worcester, Mass., *Telegram* broke the story that Thorpe had played two summers of semipro baseball—a violation of the Olympic rules requiring amateur status.

While those who had profited most from Thorpe's athletic success, notably Pop Warner and Carlisle's leaders, had almost certainly known about the summer play, they quickly took steps to disassociate themselves from the controversy. Warner dictated a letter to Thorpe, which Thorpe wrote in his own hand and read at a hearing of the American Athletic Union.

"I hope I will be partly excused by the fact that I was simply an Indian schoolboy and I did not know all about such things. In fact, I did not know I was doing wrong because I was doing what I knew several other college men had done … I have always liked sport and only played or ran races for the fun of things and never to earn money."

The confession was enough to strip Thorpe of the Olympic honors he'd earned just six months earlier. He was forced to return his gold medals, the chalice and the bronze bust—as his name was stricken from the Olympic record books. By all accounts, the change in fortune left Thorpe bewildered … and heartbroken.

"Jim was very proud of the great things he'd done," recalled Chief Meyers, a catcher for the New York Giants who later roomed with Thorpe when they were teammates. "Very late one night Jim came in and woke me up. … 'You know, Chief,' he said, 'the king of Sweden gave me those trophies; he gave them to me. But they took them away from me. They're mine, Chief; I won them fair and square.'"

"It broke his heart," said Meyers.

Scholar Robert Reising has spent three decades researching Jim Thorpe and his life on and off the playing field. Reising's conclusion? "Jim Thorpe wasn't fit for the world that celebrated him—a world where people were self-centered, egotistical and greedy. He was an Indian boy with simple desires. He was the consummate competitor, and he lived in a world that was more sophisticated than he was or ever wanted to be."

Like other modern historians, Reising points to issues of racism that motivated the proceedings. "The mainstream majority never really wanted an American Indian hero," says Reising. "It never really expected that a simple Indian boy from Indian territory would be catapulted to international fame."

Writers Robert Lipsyte and Peter Levine, authors of *Idols of the Game*, point out that the AAU investigation ended quickly once Thorpe made his confession—"before other American athletes could be charged with professionalism and disqualified."

"It was better to scapegoat one Indian schoolboy," they write, "than risk wiping out future Olympic teams."

TEAM OWNER AND ACTOR

Thorpe's story didn't end there. With Pop Warner's help, he signed a lucrative contract to play professional baseball with the New York Giants and later played professional football, and coached with Warner when he moved on to the University of Pittsburgh. Thorpe managed and played on two semipro football teams (the Canton, Ohio, Bulldogs and Jim Thorpe's Oorang Indians) and served a one-year stint as president of the American Professional Football League (precursor to the NFL), before commencing a "run of bad luck" in the form of waning crowds and ticket sales. He officially retired from sports at age 41 in May 1928.

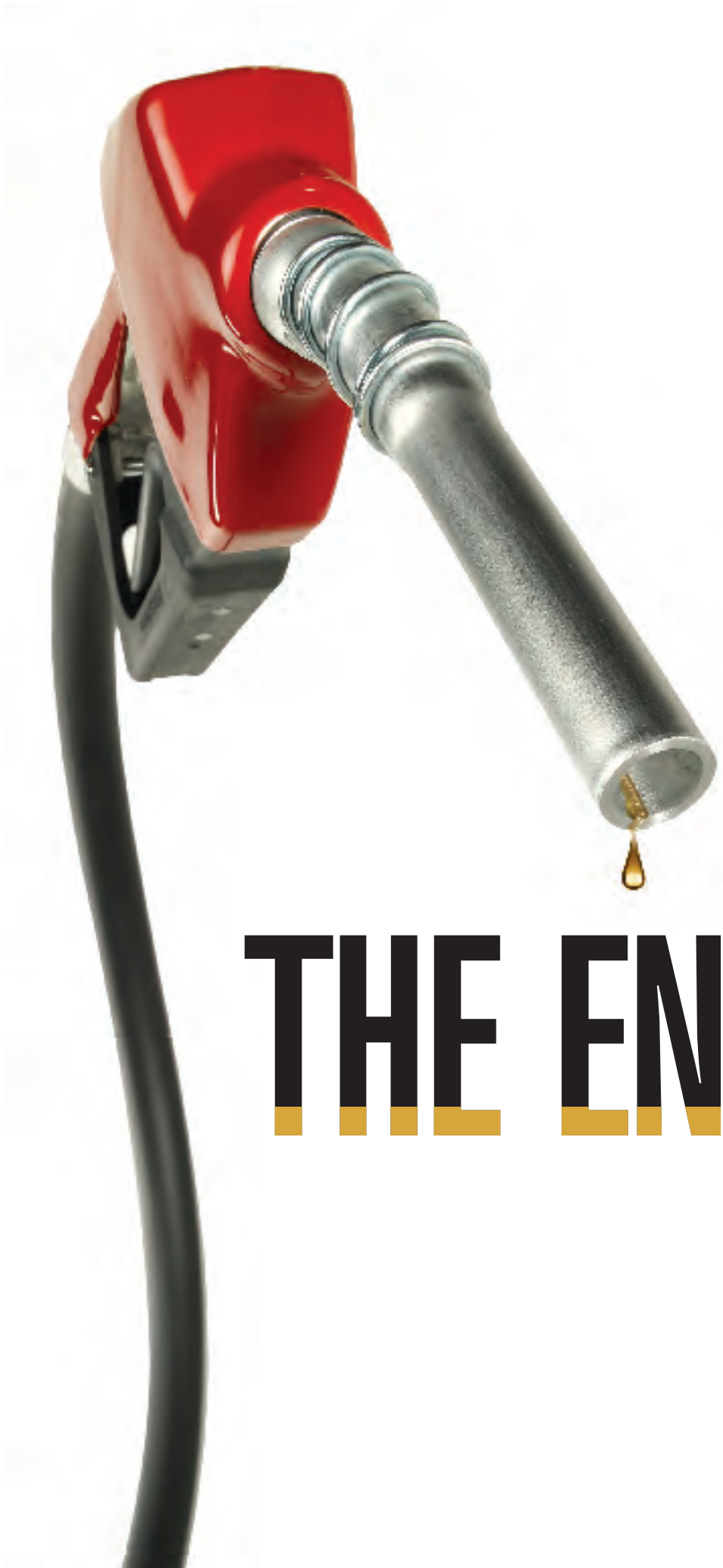
While the press has tended to portray Thorpe as a penniless drifter when he grew older, says son Jack Thorpe, who served as a leader of the Sac and Fox Indian tribe during the 1980s, "that's as far from the truth as there is." After a stint in Hollywood, where he appeared in several films, Jim Thorpe spent his later years as a bar owner, bouncer and sports director for several beach cities in Los Angeles. The movie account of his life starring Burt Lancaster, *Jim Thorpe—All-American*, was a box office hit in 1951. Because Thorpe had sold his rights away years earlier, he received just $1,500.

Jim Thorpe, the man the Associated Press named the Greatest All-Around Male Athlete and Football Player of the Half Century in 1950, died of a heart attack on March 28, 1953, at the age of 65. He left behind seven children and a third wife, Patricia Askew. Intent on preserving the legacy of her sports legend husband, she worked with the Pennsylvania towns of Mauch Chunk and East Mauch Chunk to rename the city in her late husband's honor. Today, the city of Jim Thorpe displays a monument to him in the town square with the inscription, "Sir, you are the greatest athlete in the world," and celebrates his birthday annually on May 21 and 22.

After decades of lobbying on the part of Thorpe supporters, the International Olympic Committee voted in 1982 to restore the competitor's Olympic honors, noting that Olympic rules in 1912 had required that protests be filed within one month of a competitor's victory. (In Thorpe's case, some six months had passed.) On January 13, 1983, IOC officials presented two of his children with reproductions of the gold medals. The original medals had been lost years earlier.

Reising, who travels the country at his own expense to lecture about Thorpe, donating any speaking fees he receives to the student fellowships honoring Thorpe at University of the Cumberlands, passionately believes the "world's greatest athlete" deserves to be remembered—and celebrated.

"Jim Thorpe tugs at the conscience of America," says Reising. "Every right-minded citizen knows he was treated unjustly."



THE ENERGY

Lines at the gas pumps wrapped around the block. Newspapers reported incidents of people siphoning gas out of their neighbors' cars. And to top it all off, President Richard Nixon banned the use of holiday lights.

It was November 1973. The United States was under siege—held hostage by an embargo imposed by more than half of the Organization of Petroleum Exporting Countries. Nixon banned the use of all outdoor holiday lights, even those used to decorate homes, explaining "the energy consumed by ornamental lights in this country is equivalent to 35,000 barrels per day of oil."

The West is now aware of its dependence on imported oil, but a bitter education began back in October 1973. On October 6, the Yom Kippur War began with a surprise Arab attack on Israeli positions on the holiest of the Jewish holidays. The war included the conventional conflict of tanks and planes; the outcome measured in territory and blood. Just 10 days after the war began, half of the Egyptian army was surrounded and at the mercy of the Israelis.

But Egypt and Syria had one last weapon: oil. The oil-rich Arab countries had committed themselves as allies of Egypt and Syria, and on October 17, they threatened an oil embargo of any country that aided Israel. On October 19, 1973, a

CRISIS OF 1973

Bitter lessons were learned, but the crisis in the U.S. continues

by Eugene Finerman

second war began in the Middle East, an economic struggle measured in the price and supply of oil. This conflict has yet to end.

The oil embargo was primarily aimed at the United States, the chief ally and arms supplier of Israel. In 1973, the United States was importing, according to government figures, 3 million barrels of petroleum a day from Arab countries; approximately 17 percent of the national consumption. However, political and diplomatic considerations far outweighed the economic factors. Nixon regarded the Middle East as a front in the Cold War with the Soviet Union. The Soviets had armed Egypt and Syria, so the United States stood by Israel and undertook a major airlift to provide supplies to its embattled ally.

On October 19, Saudi Arabia, Iraq, Kuwait, Libya, Qatar, Algeria and the United Arab Emirates joined the oil embargo of the United States. Ironically, the Yom Kippur War ended a week later: Israel, Egypt and Syria had agreed to a cease-fire. The embargo, however, continued. The Arab oil coalition had a tactic that could undercut support for Israel and force international pressure on the Jewish state. An oil embargo, or even the threat of one, could achieve more than the Arab armies had.

However, the Arab oil coalition did not have complete control of the world's petroleum. According to the U.S. Department of Energy, in 1973 the United States still derived 72 percent of its oil from domestic production.

SUPPLY AND DEMAND

Of the 12 members of OPEC, five kept their pipelines open for business: Iran, Venezuela, Indonesia, Nigeria and Angola. The price of their oil, however, reflected the brutal realities of supply and demand.

Before October 1973, a barrel of crude oil cost approximately $3.50. In the previous 20 years, the price had barely increased by 50 cents. In early November, however, oil was selling for $5.50 a barrel; that turned out to be a bargain. That same month, in an interview with journalist Oriana Fallaci, the shah of Iran warned of escalating prices: "Of course, the price of oil is going to rise. … There's no other solution. However, it's a solution you of the West have wished on yourself." In December 1973, the Iranian government auctioned 80 million barrels of crude oil. The highest bid was $17 a barrel.

Although the cost of the commodity had nearly quintupled in two months, it was only one component in the retail price of gasoline. The cost of refining one barrel of crude into 42 gallons of gasoline was the major expenditure in the production, and that remained stable. So the cost of a gallon of gasoline would not quintuple, but it would almost double: from 35 to 60 cents per gallon.

The higher gas prices were certainly an incentive for Iran and Venezuela, as well as domestic suppliers, but even their increased production could not compensate for the

Large crowds of cars lined up for gas at filling stations across America during the 1973 gas shortage.

absence of Arab oil. Federal officials further warned that, if voluntary conservation measures did not work, formal gas rationing would be imposed.

Gasoline stations were receiving smaller monthly allotments—15 percent less—and running out before the month was over. Consumers spent hours just looking for an open gas station. Where a station was open, a line of waiting cars frequently stretched for a half-mile. Some stations limited gas sales to $3 a person. *The New York Times* reported that one gas station in Terryville, Conn., got tired of dealing with long lines and angry customers and sold gas only by appointment.

The energy crisis tested everyone's patience and some people's honesty. Newspapers and the police blotters recorded the moral lapses. *The New York Times* noted that people claimed to be policemen or doctors in the hope of wheedling to the front of a line of waiting cars. Some gas stations could not resist price gouging.

As the winter ended, so did the oil embargo. By March 1974, the Israeli and Arab armies had peacefully disengaged and withdrawn to their 1973 borders. With the restoration of this status quo, the Arab oil producers felt satisfied and ended the embargo. The pre-war oil supply returned, but the pre-war prices did not. The quintupled price of crude oil triggered a double-digit rate of inflation in the United States that lasted more than a decade. If the cost of oil increased by five-fold, so eventually did the price of everything else. The 30-cent gallon of gas and the nickel candy bar were gone forever.

Despite years of conservation initiatives and increased domestic oil production, today America is more dependent on foreign oil than it was in 1973. According to the Environmental Protection Agency, since 1990 America's demand for oil has increased by 22 percent. The United States now consumes 20 million barrels of oil a day, and 60 percent of that oil is foreign.

And the country now has international competition for the limited supply of foreign oil. The EPA reports that China's oil consumption increased by 200 percent over the last 15 years, to 6.5 million barrels per day in 2005. The global consumption of oil now is 83 million barrels a day and is predicted to increase another 40 percent by the year 2030.

The oil embargo ended 34 years ago, but the energy crisis continues.

Living History

Colonial America is preserved in Williamsburg, Virginia

by Greg Rienzi

Despite his fame, Thomas Jefferson is much more approachable than one might think. He seems to have endless time to answer questions about his presidency and about what life was like in 18th-century Williamsburg, Virginia.

"He is Jefferson," says Kate Hoving, director of communications for the Greater Williamsburg Chamber and Tourism Alliance. Actually, he is only Thomas Jefferson while he's at work, but Bill Barker knows the part inside and out. He has been a character interpreter in Williamsburg for more than 20 years. "Bill never hesitates on an answer or comes out of character. There is nothing he says that hasn't been documented. He's spot on even when answering questions off the cuff."

While modern Williamsburg juxtaposes old and new, it's the old, with no detail spared, that annually attracts more than 4 million people from around the world.

Williamsburg, the "Colonial Capital" of Virginia, is internationally known for its restoration activities and re-creation of 18th-century America. The city is one tip of the "historic triangle," which includes nearby Yorktown and Jamestown, the first English settlement in America that recently celebrated its 400th birthday with Queen Elizabeth II of England in attendance.

Located in Virginia's Tidewater area, Williamsburg sits on the peninsula between the James and York rivers, both of which spill out into the Chesapeake Bay.

Throughout most of its early history, Williamsburg was the political, cultural and educational center of the U.S. colonies. American royalty such as Jefferson, George Washington, Patrick Henry and James Madison all at one time called Williamsburg home.

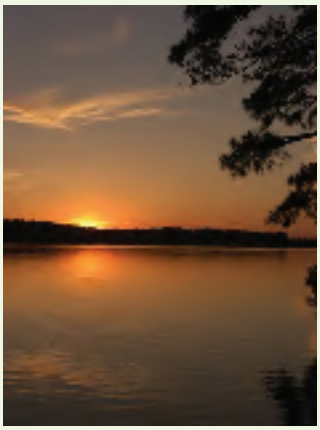
The town was originally named Middle Plantation and the site of a garrison fort, built in 1633. Sixty years later, King William II and Queen Mary II of England granted a royal charter to found the College of William and Mary, the second oldest college (behind Harvard) in the United States.

In 1696, Virginia's General Assembly voted to build a statehouse at Middle Plantation and rename it Williamsburg, in honor of the king. Royal Governor Francis Nicholson laid

Bill Barker, portraying Thomas Jefferson, takes visitors on a tour of Williamsburg garden at Colonial Williamsburg, Va., page 25. Kids can march along in Colonial Williamsburg re-enactments, top right. The Governor's Palace, bottom right; Jamestown Settlement, below.

IMAGE COURTESY OF THE GREATER WILLIAMSBURG CHAMBER & TOURISM ALLIANCE

Williamsburg Facts



THE PEOPLE: Lots of Southern charm and hospitality here, so you'll be greeted by many smiling faces. As for the historic character interpreters, just play along and have fun with what could be a very educational experience.

WHEN TO GO: If you can, avoid the summer months, which are marked by sticky heat (highs can reach 90 degrees Fahrenheit/32 degrees Celsius) and throngs of theme park crowds. Instead, visit during the fall for more temperate weather, holiday-related events (Halloween, Thanksgiving and Christmas), and to see the leaves change color.

The quietest time to go is January to March, where average temperatures range from 31 to 40 F (0 to 5 C).

WHAT TO SEE AND DO: If you bring children, or have an inner child, you'll have a hard time staying away from Water Country USA and Busch Gardens Europe, where 17th-century charm meets 21st-century theme park technology.

All visitors must explore the historic trifecta: Colonial Williamsburg, Jamestown and Yorktown. At Jamestown Settlement, visitors can board replicas of the three ships that sailed from England to Virginia and explore life-size re-creations of the colonists' fort and a Powhatan Indian village. Costumed historical interpreters mill around and describe and demonstrate daily life in the early 17th century.

Nearby is the Yorktown Victory Center, a museum that chronicles America's evolution from Colonial status to nationhood, and Yorktown Battleground.

For shopping, try Merchants Square, the Yorktown Riverwalk Landing and Prime Outlets-Williamsburg. Wine lovers should check out Williamsburg Winery, Virginia's largest winery in the form of an Old World-style village.

If you want something unusual, like a two-headed magpie or vortex tunnel, look no further than Ripley's Believe It or Not! Museum. Golf enthusiasts will be in heaven, as Williamsburg features dozens of courses, including the four-star rated Kingsmill Resort and Golden Horseshoe Golf Club.

WHERE TO EAT AND DRINK: To taste the bounty of the Chesapeake Bay, head to local favorite Berret's Seafood Restaurant, located in Merchants Square and across from the College of William and Mary. Here you'll find some of the best crabs south of Baltimore, delicious Rockfish baked in parchment paper and drinks named after the college's professors.

The Fat Canary, which opened in 2004, still ranks as one of the hottest restaurants and many locals say it's the best eatery in town. In fact, you'll need to reserve a table weeks in advance. The lively bistro serves creative Southern fare. Its odd name comes from a line in a Colonial-era poem, "Oh for a bowl of fat Canary," meaning wine from the Canary Islands.

To transport yourself back in time, look no further than Chowning's Tavern, a popular lunchtime spot (try the pulled pork sandwich). At night, Chowning's becomes a raucous 18th-century rum and ale house with light fare and "Gambols," a traditional program where Balladeers launch into period sing-alongs and costumed servers play popular games of the day. There's also the Trellis Restaurant, home to Death by Chocolate, a massively decadent seven-layer chocolate cake.

WHERE TO STAY: If you want to feel like a queen (or U.S. president), stay at the Williamsburg Inn, one of the most distinguished hotels in the states. Her Majesty Queen Elizabeth II and her husband, Prince Philip, Duke of Edinburgh, stayed in the Regency-style inn for the 400th anniversary of Jamestown. The wonderfully appointed rooms have balconies or patios that overlook the elegantly landscaped grounds.

For something a lot less regal and expensive, the Embassy Suites Hotel Williamsburg is perfectly located, minutes from Colonial Williamsburg, Jamestown Settlement and Historic Yorktown.

The Colonial Houses Hotel offers visitors a chance to fully immerse themselves in the 18th century. These 26 accommodations in the historic area come furnished with period antiques and authentic reproductions.

The Williamsburg Lodge, recently remodeled, has 323 guest rooms and suites with modern amenities and lots of Southern charm.

Of course, there is also The Fife and Drum Inn, where guests can gather under the cathedral ceiling of the common room that features a fireplace and a small library of books about Williamsburg.

IMAGE COURTESY OF THE GREATER WILLIAMSBURG CHAMBER & TOURISM ALLIANCE

Tips from a Local

Billy Scruggs grew up in Williamsburg, Va., and says he never dreamed of leaving. His wife, Sharon, shares the feeling.

In 1999, the couple realized their dream of owning a Colonial Williamsburg bed and breakfast when they transformed the second floor of a building owned by Sharon's grandfather and area merchant A.W. Hitchens. The Fife and Drum Inn was born.

Each of the inn's nine rooms celebrates an aspect of the town and contains memorabilia relating to the history of Williamsburg and the Hitchens family. It's located adjacent to Merchants Square and a short walk from the heart of historic Colonial Williamsburg, where the streets bear the same names and appearance as they did 300 years ago.

Billy Scruggs says that he walks out into history every morning and never tires of it.

"It's a very special place," he says. "The city itself is small town America that … has not gone through the downward decline that many cities go through. It's always been vibrant, healthy and beautiful."

He says he loves Williamsburg's traditions, such as the holiday lights and the Occasion for the Arts, the one-day festival in early October that now attracts almost 30,000 people annually to Duke of Gloucester Street. The oldest juried invitational art exhibit in Virginia, the event takes over the downtown area and features art, musical performances, food and a final concert called "the capper."

While not a rabid history buff, Scruggs says he and his family have had almost no choice but to become intimately familiar with details of the American Revolution and Colonial times, which he likes to impart to curious guests.

Scruggs says he still marvels at Jamestown Island beach and Historic Jamestown, a site jointly administered by the Association for the Preservation of Virginia Antiquities and the National Park Service. Since 1994, the site has undergone extensive excavation by members of the Jamestown Rediscovery project, who have uncovered hundreds of thousands of artifacts dating to the first half of the 17th century, including portions of the original James Fort that was believed to have washed away.

"In many ways, it's holy ground," he says. "I get a little shudder whenever I'm out there."

One of Scruggs' favorite area spots is the Williamsburg Inn, which six years ago added a new tearoom and first-floor bar lounge. Near the lounge is a flagstone veranda that overlooks the croquet lawn and golf course. On a warm day, it's a good bet to find Billy there, somewhere under the huge oak trees.

"It's always cool up there," he says. "It's just a beautiful spot to sit, have a drink and watch people. I don't think many folks know they can just go up there, even if they are not staying at the inn. It's probably one of the best-kept secrets in town."

out the city, which is one of the first two planned cities in America. Annapolis, Md., is the other.

In 1926, the Rev. W.A.R. Goodwin, rector of Bruton Parish Church, led an effort to preserve the city's historic buildings that had fallen into disrepair. He found a sympathetic ear in John D. Rockefeller Jr. and a massive restoration effort began. Rockefeller personally funded the preservation of more than 80 of the city's original structures and the construction of extensive visitor facilities.

Today, Colonial Williamsburg's 301-acre historic area features hundreds of restored, reconstructed and historically furnished buildings. Costumed interpreters walk the rustic and cobblestone streets and tell stories of the men and women of the 18th-century city.

The city's main street, Duke of Gloucester, runs about a mile, with the College of William and Mary at one end and the Capitol Building at the other.

Merchants Square, located at the west end of Duke of Gloucester Street, encompasses 40 retail shops and restaurants, nestled among trees and seasonal gardens.

Walk over to the east end of the historic area to see and

The College of William and Mary, left, is the second oldest college (behind Harvard) in the United States.

IMAGE COURTESY OF THE GREATER WILLIAMSBURG CHAMBER & TOURISM ALLIANCE

Costumed interpreters are seen frequently on Colonial Williamsburg's quaint streets offering perspective into what life was like in the 18th century.

take part in "The Revolutionary City" program, a two-hour interactive vignette that daily recounts the city's role in the defining period of American history, including a dramatic scene where General Washington addresses his troops as he prepares to leave for battle.

Another popular destination is the Governor's Palace, the Georgian-style residence of Virginia's royal governor and former home of Jefferson. Visitors can tour the palace, its formal gardens, the maze and the kitchen and scullery. Jefferson's grand home Monticello is near Charlottesville, Va., about a two-hour drive from Williamsburg.

The surrounding area has undergone massive growth in the past two decades and now features numerous outlet malls, world-class golf courses, folk art museums and water sports, such as kayaking on the nearby rivers.

Take your car, or rent one, and drive down the 21-mile scenic Colonial Parkway, one of the oldest stretches of road in the United States. The parkway connects Historic Jamestown and Yorktown, the site of the decisive Oct. 19, 1781, military battle that culminated with the British surrender to American and French forces under the command of General Washington.

"Williamsburg's really got a little bit of everything now, not just history, although it is a magical place for that," Hoving says. "Visitors can get art, upscale dining, spas and golf here, and nothing is more than 20 minutes away."

But don't bother to ask Thomas Jefferson where the nearest cyber cafe is. Yes, even Colonial Williamsburg has wireless Internet connections, but he's not at liberty to tell you that.

Be Productive and Safe in the 'Comfort Zone'

By Phil Kimble

Being comfortable in one's surroundings is an important aspect of being a productive worker. When we're in our "comfort zone" we can face our daily tasks without trepidation. But, an individual—or an industrial hose or fitting—in an inhospitable environment will often become unproductive and ultimately, dysfunctional.

A chemical plant decided to expand into a new line of products. These products are very dangerous to the environment and, for their safe manufacture, must be created under restricted conditions. One requirement was that an enclosed area be created so the vapors from the process would not escape to atmosphere. In fact, the vapors from this process were so dangerous that anyone entering the site was required to wear a hazmat protective suit. The selected area was perfect in that it already had most of the equipment and all the necessary water and steam connections in place.

For more than a year production went as planned. Part of the routine was the proper storage of the steam hose when it was not in use. When steam was needed, a worker would get the required number of lengths of steam hose from the storeroom and put on his or her hazmat suit to connect the hoses and open the valve inside the secured environment. It wasn't unusual for a steam connection that had been in service for a while to leak, but it usually only took a few hits of a hammer on the wing nut to stop the leak. On one occasion, the leak didn't stop and the worker decided to get a bigger hammer and show that fitting who was in charge. On the second hit, the fitting exploded, striking the worker in the head. Luckily, the blow knocked him away from the steam preventing him from getting seriously burned.

Upon investigation, it was found that the threads from the connecting spud stripped on that second big hit, which allowed the wing nut to blow off and strike the worker. Because no one at the plant had seen the threads on a connecting spud strip before, it was sent to a lab for failure analysis. The results shocked both the plant manager and the safety engineer.

The threads on the connecting spud had failed due to chemical corrosion.

When the room was set up to manufacture the new line of chemicals, the correct action of changing the connecting spuds from carbon steel to stainless steel was overlooked. In many instances, chemical corrosion is not obvious. Most of us think of rust when we think of corrosion. In chemical corrosion, the chemicals attack the metal by etching it away. In this case, the threads on the spud were eaten away until there was hardly anything left. The connecting spud didn't fail because it was hit with a hammer. It just failed a bit sooner than it otherwise would have due to corrosion.

Overlooking the little details can sometimes lead to disastrous results. We need our "comfort zone" to be productive. "Keep it safe" by making sure your industrial hose and fittings are in their "comfort zone" as well.

Making a Splash

Water sports offer great fitness possibilities

By Sue DePasquale

Whether or not you literally want to take the plunge, there's a water sport for you. From flat-water kayaking to deep-water running, the options beyond swimming for getting fit in, on or near the water are as varied as the ripples on a lake. Of course, some aquatic pastimes offer more of a workout than others.

"People often ask me, 'What about jet skiing?'" says orthopedist Jonathan L. Chang, a sports medicine specialist at the University of California in Los Angeles. "It may be a lot of fun, but you're getting a limited amount of exercise because the vehicle is doing the work." Chang puts water skiing in this same category. "Though you get some resistance against your arms and legs, most people don't stay up long enough to get a great workout," he notes.

Far better, Chang says, are the water sports that offer aerobic conditioning while also building and toning muscle. Consider the following fitness opportunities:

Flat-Water Kayaking

Though flat-water kayaking may lack the sheer adrenaline rush of its white-water cousin, this tamer version offers an effective—and enjoyable—source of exercise. Whether you choose to explore a river or stream, alone or with a partner, you'll be sure to get a great upper body workout as you execute a forward stroke with your double-bladed paddle.

And your arms aren't all that will feel the burn. A good paddle stroke starts at the feet, according to Briana and Robert Finlay of Kayak Lake Mead, near Las Vegas. "The power then transmits up through your legs, butt and abdominal region, through your torso, and finally to the paddle shaft. You'll breathe hard and use your heart and lungs to move and use oxygen." Add the benefits of strengthened joints and improved flexibility, and it's clear, they say: "Kayaking is total body fitness."

The Finlays, who lead moonlight kayaking tours on the silvery waters of Lake Mead, also extol flat-water kayaking as a stress reducer. "Spending a few hours under the sky, on the water, watching the colors of your surrounding scenery … is going to make anybody feel better and be happy."

Kayaking shells come in a wide variety of types, sizes and costs. Recreational kayaks, currently the best-selling variety on the market, offer a larger cockpit (for ease in getting in and out) and a wider beam for more stability on the water. At less than 12 feet, this variety is slower than longer boats, but lighter, easier to handle on the water, and less expensive—and it more easily attaches to the top of your car.

Rowing

Forget the image of a rowboat slowly circling a pond. If you're looking to take your water workout up a notch, then rowing may be your best bet. Running, biking, weight lifting, skiing … none offers the complete body workout that rowing does—and without putting stress on your joints. Vigorous rowing will burn considerably more calories than kayaking (about 850 per hour vs. 500) and it's guaranteed to strengthen your back muscles.

Other pluses: Rowing is versatile (you can row indoors or out, in fair weather or foul, in a boat or on a rowing machine) and it's time efficient—it doesn't take long to complete a serious workout.

If you've never rowed outdoors before, don't expect to master the stroke overnight. Unlike kayaking with its freestanding paddle, rowing involves pulling on oars that have a mechanical connection to the boat. Whether you operate a rear-facing craft (often referred to as traditional rowing or sculling) or a forward-facing variety, it's not unusual to feel awkward at first, as you struggle to keep your balance while you pull. And be prepared to feel fatigue in your upper arms, forearms and legs at the outset; these muscles will need some time to build.

Many communities and universities now offer rowing facili-

ties where you can access and store a rowing shell, join a rowing club, and get instruction.

Deep-Water Running

What started during the 1980s as a way for athletes to maintain fitness while they were injured is rapidly evolving into a popular cross-training activity for the healthy and fitness-minded.

"Deep-water running provides a fantastic aerobic workout," says Chang, and because there's no stress on the joints, "it's particularly beneficial for those with knee or hip arthritis."

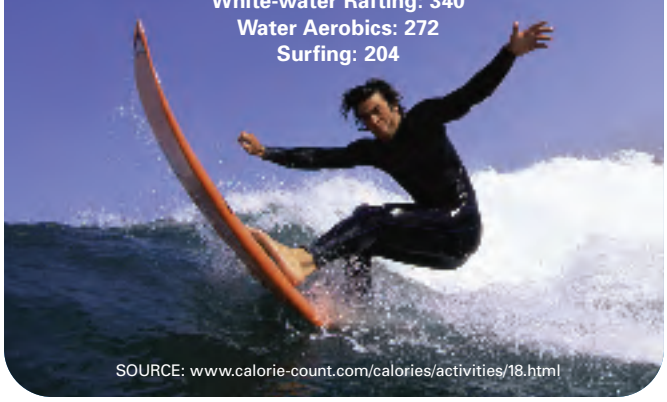
Whether you opt to do your aquatic running in a lake or a pool, you'll need water that is chest deep. And it's imperative to use a flotation device—there are several different styles of vests and belts now available specifically for deep-water running. The goal: to keep your body afloat while allowing you to perform a running motion with resistance on all sides.

If you want to further enhance your cardiovascular and strength-training workout, there are a number of hydro devices ("socks," "gloves" and dumbbells) that enable you to vary your effort and intensity.

Feel the Burn: The Calories You'll Expend ...

Calculated for a 150-pound person, exercising for 60 minutes

Kayaking: 340
Rowing (moderate): 476
Swimming/crawl (50 yds/min): 544
Water Polo: 680
Water-Skiing: 408
White-water Rafting: 340
Water Aerobics: 272
Surfing: 204



SOURCE: www.calorie-count.com/calories/activities/18.html

It can take a little practice to find the right running style underwater. Aim for short, quick strides and be sure not to "paddle"—keep a loosely closed fist and let your legs move you forward. And don't expect to get as far as you do on land—the water, of course, is there to hold you back.

Pen and Ink —All in One

The invention of the ballpoint pen

By Lisa De Nike

Even in this age of computerized everything, the humble ballpoint still serves important functions, from scrawling shopping lists on scraps of paper to signing checks and legal documents. Who among us, after all, doesn't have at least a half a dozen stuck in an old mug on our desks or on our kitchen counters?

So ubiquitous is the ballpoint pen, in fact, that it's difficult to imagine that it has only existed for about 70 years, ever since Hungarian newspaperman László Jozsef Biró decided that what the world needed was a convenient writing instrument that didn't require the user to stop intermittently to fill it up with ink.

Biró wanted his pen to utilize printer's ink, because it dried rapidly and didn't smudge. But he also knew that substance was too thick to flow easily through traditional pen nubs, so he and his brother, George, fitted the invention with a small ball bearing at its tip, postulating that the ball would acquire ink as it rotated and transfer it onto the paper as the user wrote.

It's worth noting that Biró wasn't the first person to come up with this notion; in 1888, a man named John J. Loud patented a similar device to mark leather, but that patent was never commercially exploited. Biró patented his version in Hungary in 1938 and again, five years later, in Argentina. (The Biró brothers fled Hungary for Paris several days before the Nazis' anti-Jewish laws went into effect in 1938. Shortly thereafter, they moved to Argentina in an effort to outrun the Third Reich.)

In Argentina, the Birós' newly formed Eterpen Co. commercialized the ballpoint pen, with ads boasting that it could "write for a year without refilling." In 1945, the brothers sold their patents to the Eversharp Co., which continued to make and market the product in South America.

Chicago businessman Milton Reynolds was introduced to the ballpoint pen in 1945 while on a business trip to Argentina and recognized its potential right away. Back in the United States, Reynolds founded the Reynolds International Pen Co., selling the devices at $12.50 apiece through Gimbel's department store in New York. The company sold $10,000 worth of the "Reynolds Rockets" pens the very first day on the market. At the same time, Eversharp also was aggressively marketing its version. Sales for both skyrocketed, even though their pens skipped, smeared and leaked. By 1951, consumers were tired of the pens' poor quality, and most went back to buying and using fountain pens. It seemed that the ballpoint pen craze was over.

Three years later, Parker Pens introduced the "Jotter," a ballpoint that not only came in a variety of point sizes, but also actually worked! The company sold 3.5 million the first year. A variety of other competitors (who also made vast improvements to the Birós' original designs), also quickly entered the market, including Europe-based BIC, which sold its ballpoints for between 29 and 69 cents apiece in the early 1960s. Consumers loved BIC pens for their low cost and reliability. BIC continues to dominate today's market, selling about 14 million pens a day. In fact, chances are, you have a BIC pen in that cup on your desk right now.

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