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Salt of the Earth

Where the ubiquitous staple in your shaker has its origins



SPRING 2010
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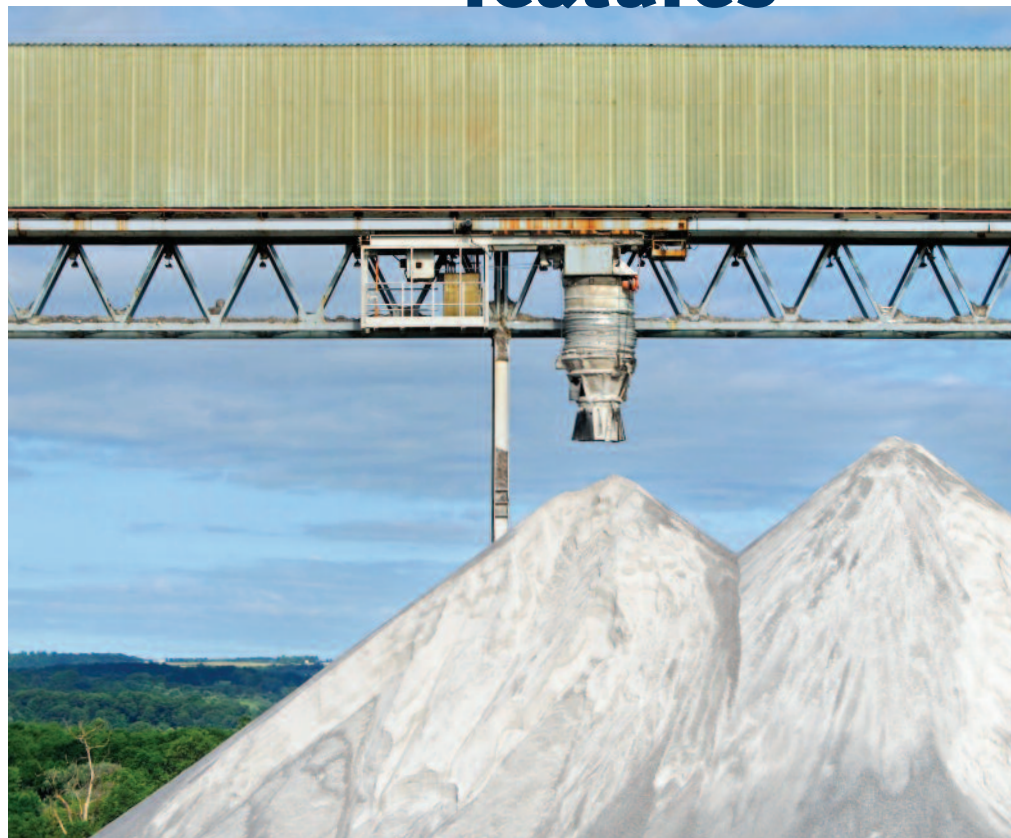
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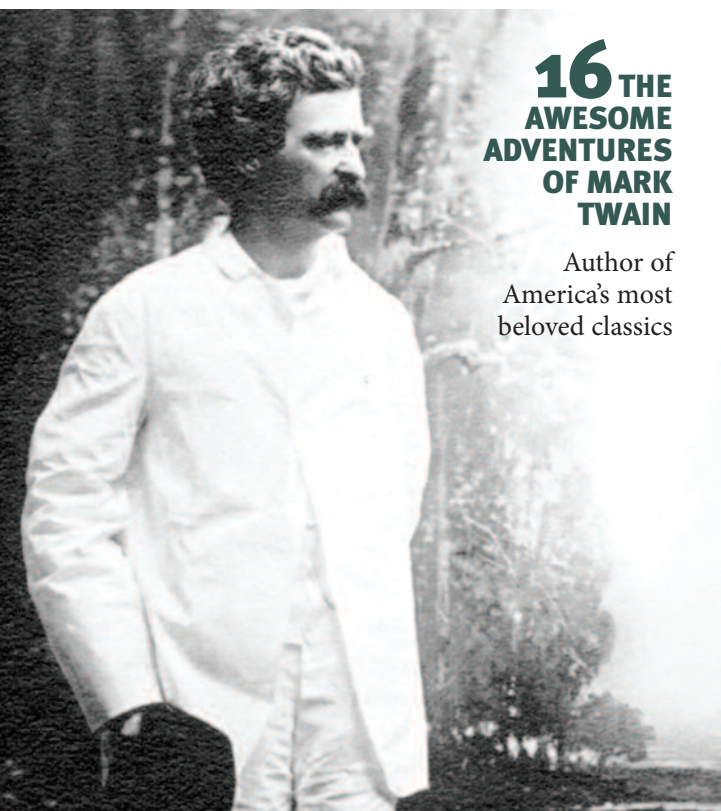
Drivers at the world's largest salt plant, in Guerrero Negro, Mexico, unload their cargo (a whopping 360 tons of crystals per load) into tanks that use brine as a cleaning agent for the newly crystallized sea salt.

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Author of America's most beloved classics



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People Power



THE IMPORTANCE OF the individual in any organization cannot be overstated. People are the key to success—in business as in life. In his best-selling business book *Good to Great*, Jim Collins emphasizes the “who” over the “what.” Collins hits the nail on the head. Without dedicated leaders like our recently retired vice president of sales and marketing, Richard Flaherty, even the best plans will fail or see limited success.

“Flats,” as he was known around Dixon, started here in 1968, and I have had the privilege of working closely with him through all these years. His greatest strength has been his uncanny ability to understand business from the customer’s standpoint. Dixon’s mission statement includes the phrase “working together to delight our customer.” Without question, Flats has always been our “who” when it came to delighting and bringing value to the customer. We thank him for his service and emphasize that without leadership like his, companies such as Dixon would not be the industry leaders they are today. Flats has been a positive “who” for more than 40 years, and we shall miss him.

As I think about Flats’ departure, I encourage you to redouble your efforts to find—and mentor—the next “who” for your company’s future. Good people are the key to success.

Thanks for reading.

Dick Goodall

BOSS

SPRING 2010

ASIA/PACIFIC – FALL 2010

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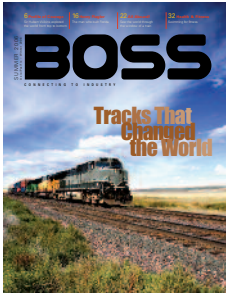
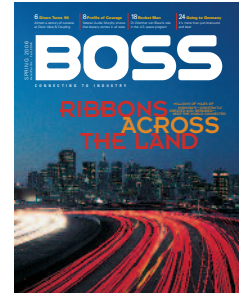
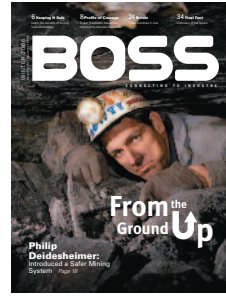
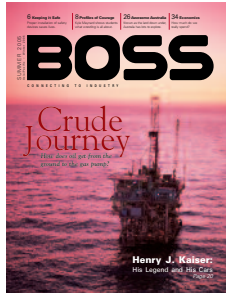
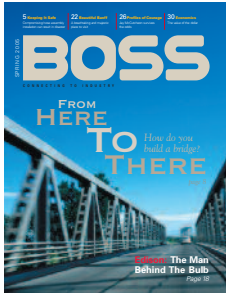
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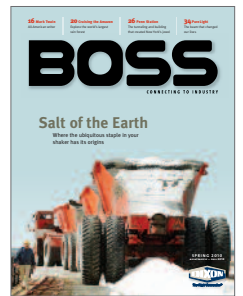
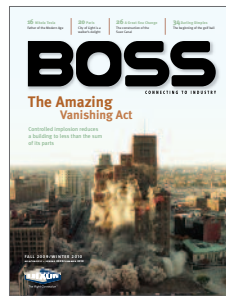
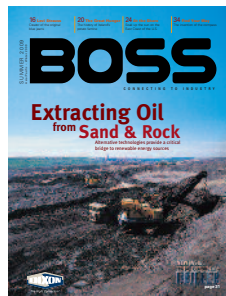
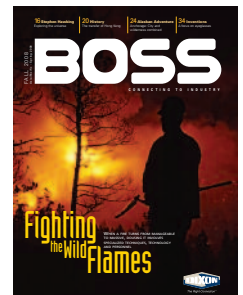
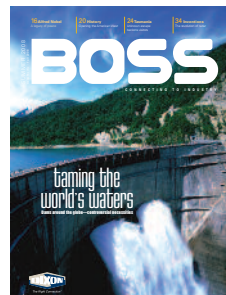
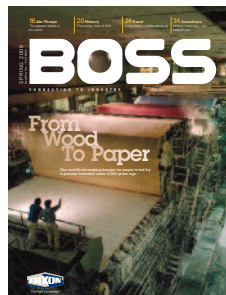
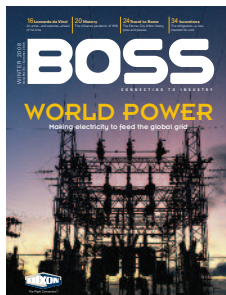
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HAPPY BIRTHDAY, BOSS!

With this issue, *BOSS* magazine celebrates its fifth anniversary. Over the past five years, we have unraveled some of the world's mysteries for you—from how milk gets to your table to how skyscrapers are built and how wildfires are fought. We hope that you've enjoyed the world as we've presented it and that you look forward to what is planned for the future.





Bobby Jones retired from competitive golf in 1930 after winning four major tournaments.

Departing with Grace

Bobby Jones continued to make his mark on the sport of golf even after becoming a legend on the links

BY MARIA BLACKBURN

In 1930 at the age of 28, an amateur golfer from Atlanta named Robert Tyre “Bobby” Jones Jr. did something that no player had ever done before: he won the U.S. Open, the British Open, the U.S. Amateur Open and the British Amateur Open, the four major tournaments in golf, all in a single year.

Called “the all-time achievement in sports history” by The Associated Press, winning the Grand Slam of golf made Jones an international celebrity, and he was celebrated in newspaper headlines and with ticker-tape parades as

the greatest golfer of all time. It is a feat that has never been repeated.

Just one month after winning the Grand Slam, however, Jones did the unthinkable. He walked away from competitive golf forever.

Retiring at the pinnacle of an athletic career is an act that’s hard to understand, even 80 years after Jones did just that. Many top athletes retire, but only a few ever stay that way, it seems. For athletes ranging from Muhammad Ali to Michael Jordan, the thrill of competition is too hard to leave behind, and so they mount

comebacks that allow them to remain in the public eye just a little longer.

For Jones, retiring from competitive golf wasn’t a publicity stunt, or the staging for a dramatic comeback. After spending half of his life playing competitive golf, the Harvard-educated attorney wanted to focus on his wife and three children and on his law career. A true gentleman, he took his winning as an opportunity to bow out gracefully.

“I’ll never give up the game of golf,” Jones said to his friend, sportswriter O.B. “Pop” Keeler, when he told him of his plans to retire. “I love it too well and it has meant too much in my life. But I

think I'd like to play the sidelines for a while. It'll be an easier and more gracious trail from now on."

The son of a prominent Atlanta lawyer, Jones was born with a natural talent for golf. He shot his first 80 at the age of 11 and his fluid swing was legendary. "One might as well attempt to describe the smoothness of the wind as to paint a clear picture of his complete swing," sportswriter Grantland Rice once said.

But Jones, who played in his first national tournament at 14, struggled with the formidable psychological aspects of the game. A perfectionist, he placed tremendous pressure on himself and often lost 15 pounds during a tournament as the result of stress. Gentlemanly and charming off the course, the young man was given to fits of rage when he failed to play up to his own impossibly high expectations. He broke clubs or threw tantrums, and in 1921 during the final day of the British Open, Jones was so dismayed by his performance that he quit in the middle of a

round at St. Andrews and was disqualified. From 1916 to 1923 (from the age of 14 to 21), he lost 10 straight major championships.

By focusing on the scorecard instead of his human opponents during competitive play, Jones was able to triumph over his demons and he started winning—and winning big. Between 1923 and 1930, he won at least one national championship every year and 13 of the 21 major championships he entered. "Competitive golf is played mainly on a 5½-inch course, the space between your ears," he said.

With retirement came many opportunities for Jones to contribute to the game he loved without having it consume his life. As well known as he was for his achievements in competitive golf, he was just as famous for his successes that came with his retirement.

In 1931, using his own clubs as a model, he designed the first set of matched irons ever produced in the United States for the Spalding Sporting

Goods Co. Later that year, he made a series of 18 short films with Warner Brothers in which he taught the principles of golf. By the 1950s, those shorts had been seen by more than 40 million people; they are still popular today. And in 1933, Jones designed and founded Augusta National Golf Course and was a founder of the Masters.

In 1955, after years of extreme pain, Jones was diagnosed with syringomyelia, a rare, debilitating nerve disease that destroyed the center of his spinal cord. He suffered for more than 20 years before dying in 1971 at the age of 69. Jones never complained or sought pity. Instead, he lived out his life the same way he retired from competitive golf, with grace and honor and dignity. "In golf," Jones said, "we play the ball as it lies."

He was a gentleman to the end, and that, more than any record, is what distinguishes Jones and always has, said writer Herbert Warren Wind. "Of all the great athletes, Jones came the closest to being what we call a great man." ■

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Salt of the *Earth*

Whether dried by the sun or harvested from underground, the salt in your shaker has been a simple but ubiquitous staple for thousands of years

BY VIRGINIA HUGHES

Despite the heat, blue skies and steady winds, the village of Ada looks something like the surface of the moon. Its eerie reflective coastline on the south Atlantic Ocean, extending about 10 miles across the southeastern corner of Ghana, is painted with sharp gray pebbles and crumbling mounds of gleaming white ore.

The rocks are made of salt, the remote village's only major commodity. The women of Ada have harvested it, by hand, every February for 300 years.

Starting around 4 a.m. on each day of the dry season, when the slush below their ankles is still cool, hundreds of women use their bare hands or shards of plastic to scrape up the wet, crusty clumps. Then they crush the salt into smaller pieces, rub off any remaining dirt, and drop them in a large wicker basket. They carry the load on their heads, 50 pounds at a time, back to shore, where it is bagged, sold and carried away by truck.

This technology, called "salt winning," is an example of solar salt evaporation—one of two industrial methods of transforming salt from its origin in the ground to the tasty crystals inside the shaker on your kitchen table. The second method mines the salt not from slushy beaches, but from huge domed deposits sitting thousands of feet below the Earth's surface. (See "Types of Salt," page 11.)

Salt buffs like to say that the mineral we know today as sodium chloride has in fact driven the economic and political development of just about every major human civilization.



“It’s always been there,” says Richard Hanneman, president of the Salt Institute. “In the prehistory, we have evidence that cavemen were settling in areas where there were salt springs, so they could get salt. Even they understood how important it was.”

Before 2,000 B.C., the ancient Egyptians discovered that fish would stay fresh—and could thus be traded—if covered in salt. Two thousand years later, overtaking towns with known salt deposits was a major strategy of the ever-aggressive Roman Empire, which often paid its soldiers in salt. In the Middle Ages, salt mines spurred development in dozens of villages in the English countryside; that’s why their names often include the Anglo-Saxon word for a saltworks, *wich*.

In the late 19th century, salt mines sprang up all over the United States and Canada. In 1930, Mahatma Gandhi led more than 100,000 people to the Arabian Sea to gather salt, thus undermining the British salt tax and pushing India one step closer to independence.

It’s not surprising, then, that in many cultures salt has come to symbolize purity and power. Jesus called his people

the “salt of the Earth.” Medieval Germans believed that spilling salt attracted evil spirits (and ever since, superstitious cooks have countered a spill by throwing a pinch of salt over their left shoulder—hoping to keep the devil at bay). In modern English vernacular, a hardworking man is said to be “worth his salt.”

Technological progress over the past century in both evaporation and deep mining methods has made salt cheap and easy to acquire in most developed countries. The total global production in 2008 was 260 million metric tons. The world’s largest salt producer is China, which produced 60 million metric tons in 2008—and then the United States, at 46 million metric tons. (See “By the Numbers,” page 15.)

UNDER THE SUN

The earliest record of salt extraction, dating to 6,000 B.C., belongs to the people who lived near salty Lake Yucheng, in the northern part of China. They harvested salt much as the women of Ada do today. Over thousands of years, the Chinese evolved the method to boiling saltwater in clay vessels and, later, in shallow iron pans.

Industry has since streamlined this basic pan evaporation process, making it much more efficient. “You can take that same land area, and instead of waiting for Mother Nature, you get pumps and dikes and you control the flow of that water,” says Lowry Redd, CEO of REDD Engineering & Construction in Salt Lake City, Utah, which provides industrial consulting for budding salt evaporators in Utah, India and West Africa. “By managing your brine ponds, you can increase your yield by many-fold.”

Some of the world’s largest solar operations are located in the San Francisco Bay, in Western Australia and in Baja California, Mexico. For these, like any successful solar venture, geography and climate are key: the facility must be near a saltwater coast, and evaporation is faster in places with steady wind and little rain. The best sun exposure is near the equator. “You want direct sunlight beating down on your ponds, and it’s better straight overhead than if it’s coming in at an angle,” Redd says. Hard clay soil helps, too. “You don’t want the water to seep into the soil and run away from you.”



Mounds containing tons of salt are ready to be bagged and shipped, far left. The aerial view of salt ponds showcases the colorful algae, which expedite evaporation, left. Gozo, an island of the Maltese archipelago, offers an environment for salt evaporation ponds to thrive, above.

TYPES OF SALT

Sodium chloride comes in many forms, each of which is suited for a variety of commercial and industrial purposes.

SEA SALT is any salt that arises from evaporated seawater. Its mineral content can vary widely, depending on what's in the water, and different combinations lead to slightly different tastes and textures.

ROCK SALT is mined from horizontal salt deposits thousands of feet underground. It's kept in fairly large chunks, and contains 5 to 10 percent mud impurities so it won't dissolve too quickly when thrown on icy roads.

BASIC TABLE SALT is usually mined from underground salt domes. After it's purified to at least 97 percent sodium chloride, it may be sprayed with iodine. Iodized salt came about in the 1920s as a public health initiative to prevent iodine deficiency, a disease that can lead to large goiters and mental retardation.

Companies that extract salt from horizontal salt deposits and salt domes sometimes make specialty salt products, too.

KOSHER SALT is just like basic table salt, except it isn't crushed into very small particles. It's so-named because of its use in making meats kosher: meat is covered in the salt to draw out all of the blood. If the particles were any smaller, they would simply dissolve into the meat.

SALT PELLETS, the jelly bean-sized capsules used for water softening machines, are formed at a manufacturing plant when salt is put under high pressures. This makes it become flexible, like plastic, and harder to dissolve.

SALT LICKS are blocks of salt—as big as 50 pounds—used for feeding animals. They, too, are made from high-pressure manufacturing systems, so they won't dissolve in rainwater.





The salt from the Dead Sea is often used to make cosmetics and bath salts, above. Salt mounds dry near salt ponds located close to Sicily, Italy, right. Salt crystals are gathered near Senegal's coastline, far right.

A solar salt facility includes a series of shallow rectangular ponds, often covering tens of thousands of acres and pumping hundreds of millions of gallons of saltwater.

First, saltwater—which naturally holds about 3.5 percent sodium chloride—is pumped into a pond and left to evaporate. The water, now much saltier, moves into an adjacent pond to dry out further. Meanwhile, a fresh load of saltwater flows into the first pond. This pumping-drying pattern continues across about a dozen ponds, so that each successive reservoir holds water with a higher concentration of salt. The purpose of connecting so many ponds is to maximize output. “The amount of salt you can put out at the end is determined by how much water you pull in the front,” Redd explains. “The more land area you have, the more ponds you can have, and the more

efficient you can be in getting that salt out of the water.”

The last pond in the series holds brine made up of about 26 percent sodium chloride. That’s a “saturated solution” in chemical terms, meaning that no more salt can dissolve in the water.

The concentrated brine is then drawn into a series of secondary reservoirs, where it crystallizes into an almost-pure sodium chloride.

Interestingly, each pond’s specific chemical makeup attracts different species of halophilic—Greek for ‘salt-loving’—algae, bacteria and small sea life. The bugs are different colors: green algae crop up in ponds with low salt; tiny orange shrimp in slightly saltier waters; and red bacteria in the saturated pools. The spectrum is not only visually stunning, but useful: the color absorbs sunlight, making the water warmer and speeding up the evaporation process.

From start to finish, it takes a given quantity of saltwater up to five years of repeated evaporations until it becomes salt. Once the salt layer is about 5 inches thick, large trucks haul it to a nearby “wash plant” for dirt and sand removal.

The final product, usually called sea salt, has a variety of uses, from cooking to cosmetics. The precise chemical makeup—and the taste and texture—of sea salt varies depending on the minerals in the water it came from. The Dead Sea and Mediterranean Sea, for example, produce popular bath salts, often marketed for their health benefits.

LAVA LAMPS

Purified dietary salt can also come from deep below the ground. Saltwater lakes from eons ago gradually dried up over time, leaving a horizontal layer of salt behind. Some of the salt beds would be exposed to more water, and more drying, adding to the salt layer. Over hundreds of millions of years, those thick salt slabs were covered, layer after layer, by rock and sediment. They’re now buried as much as 2,500 feet underground.

As part of its natural chemical properties, salt becomes extremely flexible under pressure. When underground salt layers are pushed by particular kinds of geological stress—such as the movement of tectonic plates—the salt can seep up



ON THE ROADS

In the United States, the greatest use of salt is in its rock form, 5 to 10 percent of which consists of mud particles. This doesn't meet the international standard for food-grade salt of 97 percent sodium chloride, but it's great for keeping highways ice-free.

Rock salt is mined from horizontal salt deposits (the geological predecessors of salt domes). And just as for iron, gold and coal, we can reach the horizontal slabs of salt by digging a mine.

Elevators, called "skips," take workers down the mine at about 600 feet per minute. Once they reach the salt vein, they use dynamite—which can dislodge 900 tons of salt in three seconds—to blast out a horizontal tunnel, about 60 feet wide, 25 feet tall, and up to a mile long.

With the first tunnel hollowed out, the miners will cut out a second one perpendicular to the first, creating an L shape. Then they'll blast another chamber, 100 feet from and parallel to the first one, and another one, 100 feet from and perpendicular to that. "As this thing grows, you start getting something like a crossword puzzle being cut out of this huge chunk of salt," says Morton Satin, director of technical and regulatory affairs at the Salt Institute.

This "room and pillar" method is aptly named: the 100-foot-square salt pillars left between the corridors become the walls of dozens of large rooms and support the roof of the mine. "Essentially, they make a warren,"

he says, referring to the interconnected underground areas where rabbits abound. "And it's a really neat thing to see because they're such large, spacious areas," Satin says. (Once abandoned, these sprawling underground sites have been used for industrial offices, waste storage—even for "salt therapy" spas, especially popular in Eastern Europe.)

One of the world's largest salt deposits stretches out under the Great Lakes and across southern Canada. It supports about 15 salt mines, including one at the Goderich Harbour, in Ontario—which, with 45-foot-tall rooms that span 1.5 by 2 miles, is the world's largest.

Inside the warren, front-end loaders move 12-ton shipments of blasted rock salt from the ceiling and walls into a crushing machine, which breaks them into 7-inch pieces. This is the optimal particle size for de-icing roads; smaller pieces dissolve too quickly. The rocks are then rolled onto long conveyor belts that take them to the skips and up to the surface for packaging and shipping. De-icing is the largest commercial market for salt in North America. In 2008, the United States put about 20 million tons of rock salt on the roads.





During the harvesting process, salt becomes white only after it's cleaned, above. Heavy harvesting machinery is required to manufacture salt at mines across the world, including the Camargue mine located in France, right.

through the layers in a mushroom shape, called a salt dome. “You end up with this thin tail, as the salt moves upward into a spherical formation, just like a lava lamp,” explains Morton Satin, director of technical and regulatory affairs at the Salt Institute.

To extract salt from these buried mushrooms, engineers use a micro-fracturing technique called “solution mining.”

First, echolocation or sonic detectors point to the center of the dome. Miners drill one well directly into the center, and a second parallel well about 250 feet away. Then they propel water under extremely high pressure down the first well, driving a hole into the center of the dome. Some of the salt dissolves in the water, and the massive, continuous pressure drives it out the only possible exit: the second hole.

Because the mud impurities in salt are heavier than the sodium chloride,

gravity peels them away as the brine goes up the second well. The crystals that surface are usually about 99 percent sodium chloride. “I know some plants where it's not even filtered because it's just so pure coming out the pipe,” Satin says.

Once the brine has been lifted to the surface from a salt dome, the water is dried out of it using heat and vacuum pressures. The entire drying process takes 20 to 40 minutes, says Satin. Once dried into uniform crystals, the salt is packaged and shipped to store shelves across the world.

Taking out too much salt from a given salt deposit can make the earth above sink, an event called “subsidence.” Unfortunately, that concept wasn't fully understood by the small-scale salt miners of 18th- and 19th-century England. By 1880, more than 400 buildings had been destroyed in Northwich, where salt deposits were as much as 180 feet thick. Nearby railroad lines, sewage systems and bridges also were affected.

Sinkholes still happen today, but rarely. Modern mining practice calls for abandoning a mine when the walls are still thick. Moreover, salt's chemistry makes it extremely sturdy. “Because salt

is so plastic under pressure,” Satin says, “if it gets any cracks it kind of self seals them like a rubber tire.”

This property makes salt an ideal place for oil storage. In fact, the United States Strategic Petroleum Reserve—the 700 million-barrel emergency oil supply maintained by the Department of Energy—is stored at four large salt domes on the Gulf of Mexico.

Although the precise breakdown varies widely in individual countries, about 60 percent of the world's salt is used for chemical purposes—such as making chlorine-based products for detergents and PVC pipes—30 percent for food and 10 percent for everything else—including feeding livestock, softening water, leather tanning and developing pharmaceutical drugs.

People in the salt industry like to say that there are more than 14,000 uses for the substance. That's obviously a difficult number to verify. “We don't have such a list,” Hanneman says with a chuckle. But, as his Salt Institute's Web site proudly attests: “sodium chloride touches our lives more than any other chemical compound.”

By the Numbers: Salt Production Across the World

WORLD'S BIGGEST SALT PRODUCERS

Country	2008 Salt Production, Reserves, and Reserve Base (in thousand metric tons)	Billions of Pounds
1. CHINA	60,000	132.3
2. UNITED STATES	46,000	101.4
3. GERMANY	19,000	41.9
4. INDIA	15,800	34.8
5. AUSTRALIA	12,000	26.5
6. CANADA	12,000	26.5
7. MEXICO	8,400	18.5
8. BRAZIL	7,000	15.4
9. FRANCE	6,000	13.2
10. UNITED KINGDOM	5,800	12.8
WORLD TOTAL	260,000	573.2

Source: U.S. Geological Survey, Mineral Commodities Summaries, January 2009



THE AWESOME ADVENTURES OF MARK TWAIN



One of America's favorite writers used his own exploits as fodder for his now classic tales

BY SUE DE PASQUALE

When tiny Samuel Langhorne Clemens arrived two months early, on Nov. 30, 1835, few expected him to make it past infancy. “When I first saw him, I could see no promise in him,” his mother, Jane, would report years later. The sickly little boy was bedridden for most of his first four years. It was a sorry start, particularly hard to reconcile with the image of the rough-and-tumble young adventurer who emerged afterward. Clemens’ boyhood exploits growing up in Hannibal, Mo., would serve as the inspiration for America’s most-loved novels, including *The Adventures of Tom Sawyer* and *Adventures of Huckleberry Finn*.

Known by the pen name Mark Twain, Clemens was many things over the course of his 75 years—steamboat pilot, silver miner, lecturer, humorist, essayist, anti-imperialist—but it was his gift for capturing in prose the spirit of 19th-century America that secured his status as a literary legend. “He was the first truly American writer, and all of us since are his heirs,” William Faulkner has said. H.L. Mencken described Twain as “the true father of our national literature—the first genuinely American artist of the royal blood.”

It may have been Clemens’ early confinement to home—listening to the chatter of household slaves, the drawl of visitors to his father’s general store—that honed his exquisite ear for dialect.

Samuel Clemens was 4 when his father’s failing business prompted the family to leave the sleepy town of Florida, Mo., for the bustling portside city of Hannibal. For young Samuel, Hannibal was heaven. The feisty red-



The original novel, *The Adventures of Huckleberry Finn*, is located at Bancroft Library at the University of California, Berkeley, as part of the Mark Twain Project Collection.

head became the leader of a scrappy pack of boys (a voracious reader, he was chief scriptwriter for their frequent make-believe escapades). The boys spent their summers running wild, chewing tobacco, pulling pranks and exploring the waters of the mighty Mississippi—despite the fact that Samuel couldn’t swim. He would later report being rescued from near drowning up to nine different times.

After Samuel’s dour father, John Marshall Clemens, died in 1847, his mother pleaded that he attend school, but he compromised by learning the ever-evolving printing trade. The golden age of the American newspaper was just dawning and Mark Twain was there from the start. Though he began by sweeping floors at the Hannibal *Gazette* (later the *Courier*), he worked his way up to setting type. At 15, he

apprenticed with his older brother, Orion, the paper’s new publisher. It was inside the ink-spattered walks of the *Courier* that Twain’s sharp wit first found an outlet. His first piece, “A Gallant Fireman,” blended fact with fiction to lampoon a young co-worker whose response to a Hannibal grocery store fire was to rescue a broom and a dirty towel.

After touring the East Coast for several years, Twain was lured back to the Midwest by the increasing popularity of the steamboat. He set out to “learn the river” as an apprentice to pilot Horace Bixby, who was later immortalized in Twain’s classic book *Life on the Mississippi*. (He also earned his pen name. Steamboats needed a water depth of at least 12 feet to avoid running aground, so seamen would drop a weighted rope, with “marks” every 6 feet.

Twain means two—thus “Mark Twain” indicated the water was safe to navigate.)

Twain’s riverboat years were a short-lived but idyllic time in his life. Sadly, they ended in tragedy when his beloved younger brother, Henry, whom he’d convinced to work on the river, was killed in a steamboat boiler explosion. “My poor Henry—my darling, my pride, my glory, my all ... has [finished] his blameless career, and the light of my life [has] gone out in utter darkness,” Twain, then 22, wrote to his family with the news of Henry’s death.

The advent of the Civil War put an official end to Twain’s river piloting days. With friend Will Bowen and some others, Twain reluctantly signed on with a local Confederate militia, the Marion Rangers. But his heart wasn’t in it (he didn’t abide slavery) and his military “career” with what amounted to a ragtag group of friends lasted only several weeks. He later wrote about the experience in an essay, “The Private History of a Campaign That Failed.”

Determined to avoid the conflict of the war, Twain set out for the West, once again joining brother Orion, this time in Nebraska, and later Virginia City,

Nev., where the two hoped to make their fortunes in silver mining. While that never happened, Twain did gather great fodder for a future book, the semi-autobiographical *Roughing It* (1872) and returned to the newspaper writing he had set aside by working as a humorist for Nevada’s biggest paper, the *Territorial Enterprise*. He moved on to San Francisco in 1864 and it was there he penned the piece that would bring him his first real fame, “The Celebrated Jumping Frog of Calaveras County.” Picked up by the *New York Saturday Press*, it “set all New York into a roar,” and earned praise from influential literary critic James Russell Lowell as the finest piece of humorous writing ever produced in America.

Twain was ready to return East, but first he embarked on a pleasure cruise for Europe, where he wrote about his encounters there in the highly satirical *The Innocents Abroad*, which became a best-seller. Twain arrived in New York, at 35, as a literary darling. On that cruise, friend Charley Langdon had shown him a picture of his sister, Olivia. Twain was smitten. Back in the U.S., he set out to find her and win her over—no easy task given how shy and refined she was.

Gradually, though, she fell in love with him; some say it happened when she saw him on the lecture platform. The two married in 1870, embarking on a romance (including the birth of three daughters, Susy, Clara, and Jean, and a son who died as a toddler) that would carry them through the next four decades, until Olivia’s death in 1904.

The Twain family spent the happiest years of their lives (from 1874 to 1891) in a sprawling, 19-room home in Hartford, Conn., with a spacious lawn, stable and coachman. Even before *The Adventures of Tom Sawyer* was published in 1876, Twain had begun work on a continuation, focusing on Tom’s friend Huck. He wrote a sizable portion but then set the new book aside. “I like it only tolerably well, as far as I have gone, and possibly may pigeonhole or burn the manuscript when it is done,” he wrote at the time.

Thankfully, that never happened. Twain returned to Huck in 1883 and the book began to “write itself.” “I haven’t piled up [pages] so in years ... Why it’s like old times,” he reported happily.

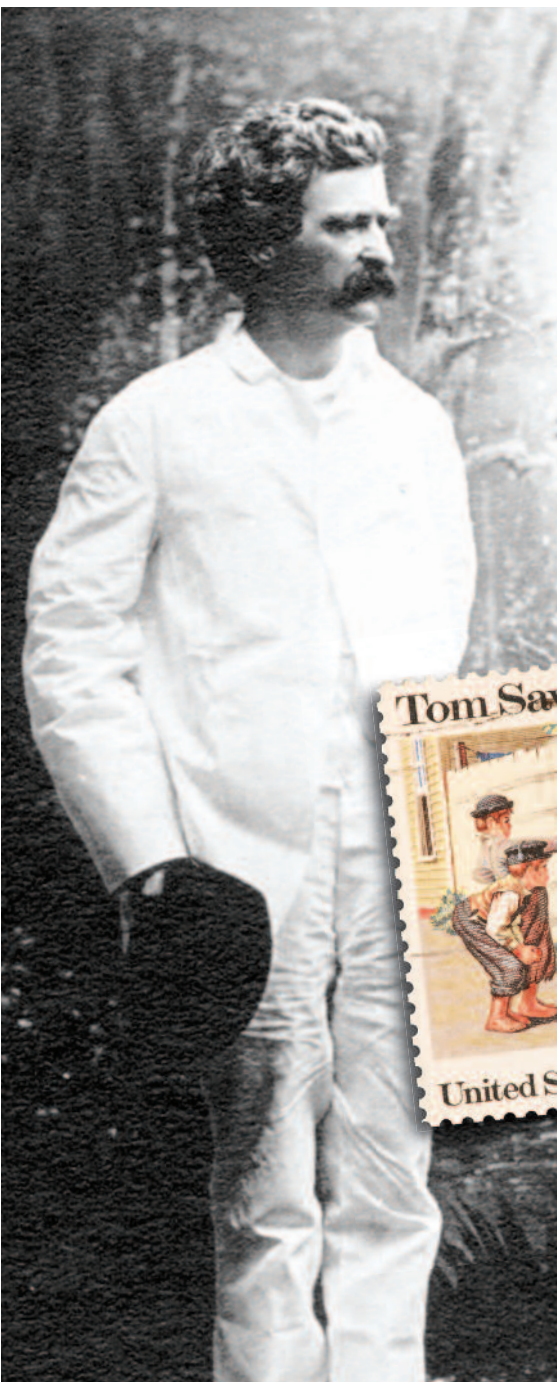
Adventures of Huckleberry Finn masterfully depicts young Huck’s grappling

For 17 years, the Twain family lived in a 19-room Victorian, Gothic-style home in Hartford, Conn. It now serves as a museum.



Quotable Quotes from Mark Twain

- "I have never let my schooling interfere with my education."
"Clothes make the man. Naked people have little or no influence on society."
"Courage is resistance to fear, mastery of fear—not absence of fear."
"A lie can travel halfway around the world while the truth is putting on its shoes."
"It's not the size of the dog in the fight; it's the size of the fight in the dog."
"If you have nothing to say, say nothing."
"Always do right! This will gratify some people and astonish the rest."
"It is easier to stay out than get out."
"Actions speak louder than words but not nearly as often."



with right versus wrong in his rafting journey down the Mississippi River. It's hard to overstate the impact of the book that Twain published in 1884 (in London) and a year later in the United States. "All modern American literature comes from one book by Mark Twain called *Huckleberry Finn*. There was nothing before. There has been nothing as good since," wrote Ernest Hemingway.

In his later years, Twain found time to indulge his lifelong fascination with science and technology. He developed and held the patent on an "adjustable and detachable garment strap," and worked to improve the kaolatype, a machine that promised to speed up production of engraved illustrations (though it ended up losing him money).

Twain's passion for science was no doubt nurtured by his close friendship with Nikola Tesla, the scientist widely credited with making electricity a commercial reality. The two frequented the Player's Club, in New



York City, and in 1894, Tesla famously invited Twain to his lab, where the first photos to make use of phosphorescent light were taken.

On a later lab visit, Twain served as a guinea pig to test Tesla's newly developed mechanical oscillator, an engine that produced alternating currents of high frequencies—as well as significant vibrations. Were there health benefits to be had from these vibrations, Tesla wondered? Twain gamely endured being hooked up and shaken ("This gives you vigor and vitality!" he shouted) until the laxative effect of the vibrations caused him to bolt for the bathroom. (See the biography on Nikola Tesla in the fall/winter 2009 issue of *BOSS* at www.dixonvalve.com.)

As the 19th century drew to a close, Twain became a staunch anti-imperialist, passionately against U.S. plans to annex the Philippines. "I am opposed to having the eagle put its talons on any other land," he declared to reporters. From 1901 until his death nine years later, he served as vice president of the American Anti-Imperialist League; through his dark-toned lectures and essays, Twain became a primary voice for dissent.

But today, Twain, a man who befriended presidents, industrialists and European royalty, is remembered much more happily—for his humor and his genius in depicting Americans as they really were.

"Mark Twain's way of seeing and hearing things changed America's way of seeing and hearing things," notes biographer Ron Powers. "As America's Shakespeare, [he] struck a template for the nation's voice into the 20th century and beyond." ■



CRUISING THE *Amazon*

A trek formerly reserved for only the hardest adventurers can now be a luxurious trip through the world's largest rain forest



BY GREG RIENZI

On day two of his traditional Amazon River and Negro River nature cruise, Carlos Probst takes guests out for some early afternoon piranha fishing. Probst makes the ship's captain guide the 70-foot shallow-hull riverboat toward the lush tree-canopied shore, so that passengers can depart on canoes to do battle with the notoriously ferocious fish.

The tackle is simple: bamboo rod, fishing line and a hook. For bait, Probst prefers raw meat, but anything will do for this not-so-finicky scavenger. He deadpans if anyone is willing to spare a finger.

The joke invariably gets laughs from a crowd of around 16 who have already had a full day of activities. Even before breakfast, passengers were treated to a dramatic Amazon River basin sunrise and a

“Here we have the most species of plants, animals and insects in one natural paradise.”

—Carlos Probst,
Amazon Clipper Cruises

The omnivorous, freshwater piranha, far left, has tightly packed teeth and is found throughout the Amazon. Mangrove trees populate the rain forest, right. Squirrel monkeys jump from tree to tree in the rain forest’s canopy layer, below.

bird-watching canoe trip to see such winged creatures as egret, macaw or hoatzin, pheasant-sized tropical birds known for their spiky head crests.

After a meal and some slow cruising, passengers go on land for a guided tour of the rain forest followed by a visit to a small coastal village whose inhabitants subsist off the river and forest. Then it’s back on the boat for lunch and more cruising. The day ends with dinner onboard and a night trip to see nocturnal animals such as snakes, alligators, sloths and toro-rats. To spy the creatures, a guide shines a headlamp on the water and land to reflect the animals’ eyes.

And it’s only day two of a six-day journey into the planet’s most diverse ecosystem. Like the online retail giant that bears its name, the Amazon River offers up a seemingly endless bounty—and a little something for everyone.

In recent years, the river cruise business has exploded, a trend that mirrors the overall boon in ecotourism. Roughly 50 years ago, an Amazon River tour amounted to a day trip on a small wooden boat. Over time, the industry grew, and so did the boats. New outfitters popped up to offer three-day to weeklong cruises on 50- to 60-foot riverboats that featured small cabins with bunk beds, toilets and eventually air conditioning.

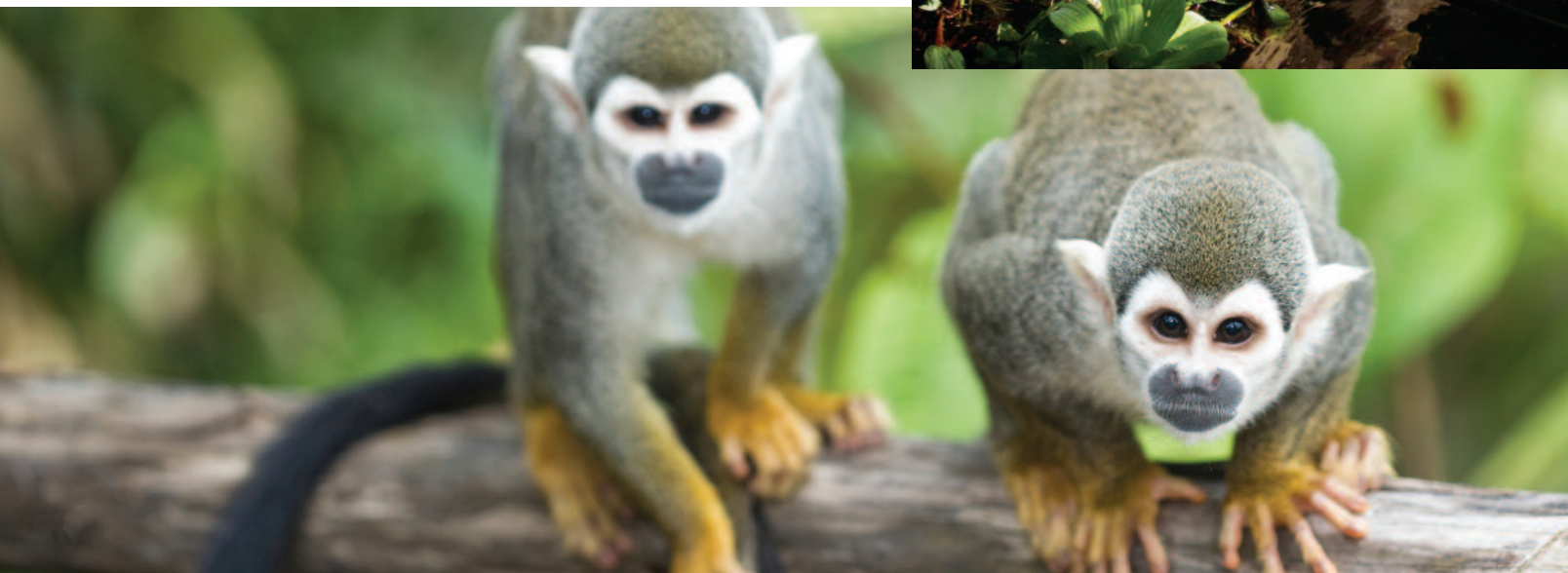
Probst, founder and owner of Amazon Clipper Cruises, started his business 25 years ago. Today, he has a fleet of five boats ranging from the 66-foot *Amazon Clipper* to his newest vessel, the 106-foot luxury riverboat named the *Premium* that allows guests to cruise the Amazon

in pampered, five-star style. The *Premium*, which features spacious cabins with cozy beds and hot showers, in 2007 hosted German President Horst Kohler and several German ministers. Probst actually counts several celebrities among his clientele, but he’s wary to name drop.

Probst says what draws people of all sorts to the Amazon is the region’s rich symphony of life.

“They come for the ultimate environmental experience in the world,” Probst says. “Here we have the most species of plants, animals and insects in one natural paradise. And we can make it all possible in comfort, and in one trip.”

The Amazon River, which stretches from the Peruvian Andes across northern





The Amazon River stretches from the Peruvian Andes across northern Brazil to a wide delta on the Atlantic Ocean (left). With thousands of tributaries and subtributaries, the Amazon is the largest river in the world by volume; its total flow is greater than the next eight largest rivers combined.

Amazon Essentials

How to get there: Fly into Manaus' Eduardo Gomes International Airport, which serves most major carriers and has direct flights from Atlanta, Miami and Panama. Shuttles and taxis will get you into town. A popular accommodation is the Tropical Manaus Hotel, situated on the shores of the Negro River.

The hotel, more a resort, features spacious and comfortable Colonial-style rooms, all with air conditioning. The 594-room hotel is an ideal starting point for visiting the Amazon rain forest and its grounds are filled with trees full of singing birds and wild monkeys.

When to go: Amazon River tours are offered year-round. In the Amazon basin, flooding often occurs between June and October. The rainy season starts in November and ends in April. If you plan to go between June and September, tour operators recommend that you book a reservation at least six months in advance.

Weather: The climate is warm and humid, with an average temperature of 79 degrees Fahrenheit (26 degrees Celsius) and an average yearly rainfall of 80 inches.

Language: The official language is Portuguese, but English is spoken nearly everywhere.

Nature's predators: The Amazon's bark is worse than its bite. True, the river contains alligators, piranhas and snakes, but most keep to themselves and attacks on humans are rare. Snakes, for example, will attack only if they feel threatened. There are mosquitoes, but they are not nearly the nuisance one would think. On the boats and in the jungle lodges, rooms and open areas are screened. Even so, repellents are recommended.

Public health: Waters from the Negro and Amazon rivers are not polluted despite their color and are fine for swimming. Visitors should be vaccinated against yellow fever, but anti-malarial shots are not needed.

Money: The national currency is the real, but euros and U.S. dollars are accepted at many stores. Some banks and agencies are authorized to exchange money. Hotels, travel agents, jewelry stores and airlines will accept all international credit cards, but restrictions will be made by some restaurants and in small stores when shopping for arts and crafts.

What to wear: Bring light clothes, cotton shorts, a hat and T-shirts. Sunblock lotions are recommended during the summer. The nights can get cool, so pack some long pants and a jacket, too.



The city of Manaus, Brazil, also known as the "Paris of the tropics," is the main hub for Amazon River tours.

Brazil to a wide delta on the Atlantic Ocean, was believed to have been named by Spanish explorer Francisco de Orellana in 1541 in honor of the female warriors he encountered on his voyage through the territory previously called Maranon.

The Amazon River basin is roughly 4,200 miles long and covers about 2.72 million square miles in area, including its 15,000 tributaries and subtributaries. Two-thirds of this area is filled with the world's largest and oldest tropical rain forest that supports a profusion of life.

The width of the river ranges from one mile to 35 miles, although the thousands of islands that dot the river make it appear narrower in many locations. Most of the Brazilian part of the river exceeds 150 feet in depth, although portions near the mouth reach nearly 300 feet.

The city at the heart of the basin and the capital of the state of Amazonas is Manaus, the "Paris of the tropics," which lies along the north bank of the Negro River. Manaus, the one-time port town that today is a sprawling metropolis, is situated on a terrace overlooking the river and is the main hub of nearly all Amazon River tours.

In general, the tours range from three days and two nights, to six days and five nights, and can cover from 150 to 350 miles [241 to 563 kilometers] of river.

The Amazon River basin is roughly 4,200 miles long and covers about 2.72 million square miles.

Amazon Essentials (continued)

Do this: Fish for peacock bass, a favorite of anglers worldwide. These bass, which can range from 10 to 50 pounds [4.5 to 22.7 kilograms], put up a nasty fight and can jump several feet out of the water.

Eat this: Piranha soup, a local delicacy and reported aphrodisiac. If you find pirarucu fish on the menu, order it. In addition to being one of the largest freshwater fish in the world—pirarucu can grow up to 8 feet long and weigh more than 220 pounds [98 kilograms]—it's also rather tasty, especially cooked over charcoal.

What to do in Manaus: The town's origin goes back to a Portuguese fortress built there in 1669.

Arguably, the town's most distinct landmark is the Amazon Theatre, an opera house that opened in 1896. Made during the rubber boom, no expense was spared to make it the grandest opera house in the world. Its construction was done in eclectic and neo-classical style, with nearly every element imported from Europe. The wrought-iron staircases, for example, were brought in from England and the crystal chandeliers from France. Even the Brazilian wood used was sent to Europe to be polished and carved. The building is crowned by a golden cupola inlaid with 36,000 ceramic tiles and painted the colors of the Brazilian flag. The building's Noble Room, decorated by Domenico de Angelis, was made with 12,000 pieces of wood fitted together without the use of nails or glue.

In case you didn't get enough wildlife on the cruise, check out the Amazon Natural Science Museum, where a large variety of embalmed animals and insects can be seen.

Those who appreciate a good engineering marvel should go down to the floating docks that rise and fall with the Negro River's water level, which can range over 10 meters. The docks, inaugurated in 1902, serve ocean-going vessels.

To get a shopping fix, go to the Municipal Market, a replica of the former Les Halles Market in Paris. Here you can buy all sorts of Amazonian products, such as hammocks, stuffed piranhas and bio-jewelry made from seeds and other materials originally found in the rain forest.

A popular first stop is the "Meeting of the Waters," an area 11 miles from Manaus [17.7 kilometers] where the Amazon and Negro rivers converge but, because of temperature and density, don't mix. The result is a miles-long swirling soup—think cream poured into black coffee—of the dark slow water from the Negro and the "white" muddy water from the Amazon.

From this point onward the true adventure begins.

Riverboats navigate down the river to the Xiborena region for canoe trips to small creeks to see life on the flood plains. A welcome sight are several species of monkeys, including squirrel, spider and howler, which can be viewed from the boat as they swing from trees. If you're extremely lucky, you might spot a resting jaguar in the treetops.

When the water level is low, the river teems with giant water lilies, which are large enough to lie on. In fact, alligators can be seen resting on them.



The round leaves of the largest water lily in the world, also known as the *vitoria regia*, reach 2 meters [6.5 feet] in diameter, left. The venomous two-striped forest pit viper dwells in the lowland of the rain forest and feeds on small mammals, above. The "Meeting of the Waters," where the dark slow water from the Negro River meets with the Amazon's "white" muddy water, far right.

It's then up the Amazon to Lake Janauaca and a visit to January Ecological Park, an ecological reserve that offers a unique opportunity for tourists to discover many species of plants and wild creatures. Located on the Negro River, just 45 minutes by boat from Manaus, the park unites several ecosystems of the region.

Many tours feature guided walks into the rain forests, with commentaries by area experts. These side trips also allow visitors to see the local way of life, such as the preparation of manioc flour, an Amazon staple.

Another Amazon River cruise favorite is a jaunt through the Anavilhanas Archipelago (chain of islands), the largest of its kind. The Anavilhanas is made up of 400 islands and hundreds of lakes, rivers, swamps and sandbanks, all rich in animal and plant life. The area, protected by federal law, is a paradise for biologists and ecologists.

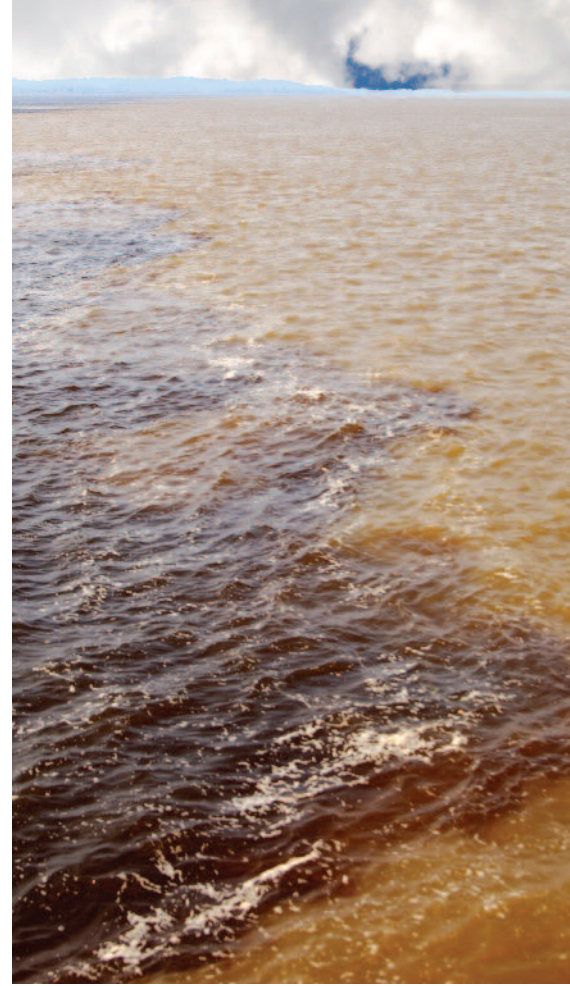
From November to April, the high water season on the Negro River, half

the islands are submerged, forcing the animals to take refuge on higher ground.

Anavilhanas is near the Jaú National Park, the largest forest reserve in South America at 5.6 million acres. It is named after the park's main river, and one of the largest Brazilian fish. Jaú Park features several breathtaking waterfalls.

Toward the end of his tours, Probst makes sure that guests get a chance to swim in calm tributaries with the famous Amazon River dolphins. He says the experience is unforgettable.

"The whole journey, in fact, brings you a completely different view of life," he says. "You see a native people integrated with nature, living a very simple and happy life. The experience also dispels some people's notion of the Amazon as a place with rampant destruction. To get here, you fly over uninterrupted forest for more than two hours. You see the awe of the Amazon just arriving here." —



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MILESTONES IN HISTORY



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The Building of New York's PENNSYLVANIA STATION

BY JILL JONNES



PHOTO COURTESY LIBRARY OF CONGRESS

Seventh Pennsylvania Railroad President Alexander Johnston Cassatt died in 1906, just four years before the rail station was completed.

In spring of 1901, Pennsylvania Railroad President Alexander J. Cassatt debarked his Pullman Palace car at the Jersey City Exchange Place Terminal, and joined the crowds streaming onto his company's huge double-decker ferries to cross the Hudson River. For 30 years, it had galled Cassatt to know that every New York-bound Pennsylvania Railroad (PRR)

passenger—some 40 million people a year—had to take a ferry. “I have never been able to reconcile myself,” Cassatt had once said, “to the idea that a railroad system like the Pennsylvania should be prevented from entering the most important and populous city in the country by a river less than a mile wide.”

The very waters that encircled the port city of New York and made her so rich and powerful were now starting to strangle her rambunctious growth, for no bridge or tunnel connected New York City to the mainland. Ten railroads came to a halt at the Jersey shore, while the Vanderbilts' New York Central trains steamed into

the city by crossing the river higher up at Poughkeepsie, traveling down the east bank of the river, and in to northern Manhattan over the Harlem River. Under Cassatt's aggressive leadership, the mighty PRR hoped at long last to enter New York by backing the construction of the long-planned North River Bridge, a gargantuan \$90 million, three-decker span [equivalent to \$2.3 billion today] that could accommodate all the

railroads stuck on the Jersey shore. But by summer of 1901, the bridge was dead: the other railroads balked at paying their share.

While in Paris that August visiting his sister, the artist Mary Cassatt, the PRR president inspected one of the city's train stations, the Gare d'Orsay, there finding the possible solution. Perhaps the PRR, too, could use electric-powered locomotives to enter Manhattan under, rather than over, the river. (Steam engines operating in a mile-long tunnel would asphyxiate the passengers.)

Cassatt quickly sailed back to New York with Charles Jacobs, the preeminent English engineer of sub-aqueous tunnels, and Jacobs was soon spending nights on a PRR tugboat secretly probing the Hudson's riverbed. Jacobs informed Cassatt on Nov. 8 that the PRR could indeed build its tunnels 40 feet below the riverbed.

The caveat? The grade of those tunnels dictated that they emerge—not at a derelict railyard on the far west side of Manhattan as Cassatt hoped—but in the West 30s, the city's infamous vice district known as the Tenderloin. Soon, the PRR was quietly buying up 28 acres of real estate in the shabby blocks filled with bordellos, opium dens and wild dance halls. By January 1903, after a fierce political battle to obtain the needed city franchise, demolition and clearing began.

Cassatt's colossal engineering project, known as the New York Tunnels and Terminal Extension, would begin in the Jersey Meadowlands, blast two tunnels through the Bergen Highlands, and then begin descending far below the Hudson River. Those two tunnels would then enter 40 feet below Manhattan at

Riding the Rails

During World War II, when Penn Station served only the PRR and the Long Island Rail Road, 109 million passengers arrived or departed on trains in 1945.

Today, Penn Station serves the Long Island Railroad, Amtrak and the New Jersey commuter lines, and about 200 million passengers pass through each year, making it the busiest station in the United States. Both Waterloo Station in London and the Gare du Nord in Paris handle comparable numbers.

But it is Japan, a nation famous for its top-speed rail travel, that boasts the world's truly busiest train stations. Tokyo's Shinjuku Station serves 3.6 million passengers a day, followed by another Tokyo Station, Ikebukuro, which serves about 2.7 million people a day. In two months, as many passengers come and go in Shinjuku Station as go through Penn Station in a year!

the new West 34th Street train station. From there, four tunnels would cross town below the city streets, heading down again under the East River. The two PRR tunnels would end in the new Sunnyside Yards in Queens, while the two Long Island Rail Road tunnels would continue on out to the island. All told, 16 miles of tunnels had to be built. Samuel Rea, who had joined the PRR as a 16-year-old rod-and-chainman, supervised this \$100 million engineering project that would forever transform the physical and psychic geography of New York City.

Pennsylvania Station would serve as the visible crown jewel of this monumental but largely subterranean work. On April 23, 1902, Cassatt bestowed that plum commission upon architect Charles F. McKim of McKim, Mead & White, who had never designed a train station in his life. But McKim



New York architectural firm McKim, Mead & White used glass-and-steel train sheds in 1904 for the construction of the station.

understood, as no other man in America, grandeur, the city nicknamed Gotham and the monumental. Inspired by the great buildings of Rome, McKim designed Penn Station to be of imperial scale, its façade an imposing colonnaded temple to transportation. Inside, McKim's Penn Station would evoke the classical past in its luminous General Waiting Room, a space of extraordinary height and grandeur that drew on the architect's memories of a visit to the ruins of the Roman Baths of Caracalla.

On June 24, 1903, Charles Jacobs gathered with his junior engineers on the west side and drilled the historic first hole for the Hudson River tunnels, dispatching the drill to Cassatt as a souvenir. And so began the actual digging for a civil engineering work of extraordinary ambition, scale and peril. Engineers pushed the two Hudson and four East River tunnels simultaneously. As soon as the shafts were sunk, the engineers began assembling on each end of the tunnels the Greathead shields, strange 193-ton behemoths of machines, gigantic mechanical moles that would burrow deep under the river, leaving in their laborious wake the new tunnel. Greathead shields were assembled at the ends of each tunnel. Once under the rivers, the "sand hogs," as the tunnel workers were nicknamed, worked in compressed air (with serious risk of the

"bends" or decompression sickness, where excess nitrogen can form dangerous bubbles in the body) as they pushed the shields forward, assembling the 13 sections of each 23-foot-wide cast-iron tunnel ring one after another. The tunnels grew, looking in their raw state like long, segmented snakes.

The PRR tunnelers had to be sure not to damage the New York piers or harbor bulkheads overhead. Once out in the rivers, problems arose with quicksand. The tunnels were piped full of compressed air, which held the river water at bay. But sometimes that compressed air found a way to escape, and these deadly "air blows," as they were called, especially plagued the East River tunnels. When the tunnel "blew," terrifying floods of water cascaded in. Every foot of the way, the alignment engineers were measuring to be sure the tunnels were on track to meet up and join in the middle of the rivers.

Meanwhile, a gigantic hole was being blasting and excavated in the Tenderloin, for the site for Penn Station had to be 50 feet deep. Such was the spectacle, that day and night, crowds watched the blasting, peering into the evermore gargantuan canyon, where little trains hauled away the debris via specially constructed elevated rail lines that led to the West Side piers and awaiting barges. The amount of debris was so

substantial that it was used to fill in wetlands in Greenville, N.J., to create an additional rail yard for the PRR.

As the tunnels neared completion in 1908, New Yorkers were amazed to watch what seemed to be an ancient monument rising on shabby 7th Avenue—McKim's magnificent Roman temple, a strange classical vision with its austere columns carved from rosy-hued Milford sandstone. By now, sadly, Alexander Cassatt, 67, had died, succumbing in late 1906 to the strains of the PRR presidency. Samuel Rea, who assumed full charge of the project, had his own tragedy: the death of his only son, a junior engineer, from a flu contracted working in the PRR tunnels. Charles McKim's health was also failing. And yet, the great PRR project moved inexorably forward.

On the Saturday evening of Nov. 26, 1910, at 9:30 p.m., huge crowds of New Yorkers swarmed in for their first glimpse of the newly opened station that would finally connect their island to the mainland. Penn Station was so vast—covering 7.5 acres and occupying a volume of 40 million cubic feet—it absorbed the multitudes in grandeur. The station's General Waiting Room had a timeless quality, its towering classical columns lifting the eyes to the groin-vaulted ceiling. The marble had a spare and somber beauty, its feeling of antiquity belied by the massive chandeliers and

elegant pale blue map murals depicting the PRR's rail lines. "In thousands the [throngs] flooded the acres of its floor space," reported the *Tribune*, "and gazed like awestruck pygmies at the vaulted ceilings far above them, inspected curiously the tiny details of the place, so beautifully finished."

Passengers catching the first trains from the new concourse marveled at McKim's version of the familiar Victorian train shed: a railroad cathedral of light and dramatic motion, an airy rhythmic space of repeating, vaulted lacy steel-truss umbrella arches, the glass skylights supported by tall slender steel pillars. Cassatt and Rea had bestowed a gateway worthy of the nation's most important city.

As the decades passed, the great age of passenger rail was ending. In 1945, the war forced the station's use to a new high-water mark: 109 million passengers. Thereafter, automobiles and airplanes became the glamorous post-war modes of transportation. By the late 1950s, the once-mighty PRR was struggling, and management, viewing New York's Penn Station as a shabby albatross, sold the area above the station to the developer of the new Madison Square Garden and skyscraper.

On Oct. 28, 1963, as the very skies seemed to weep a gentle rain, desecration and demolition began. Penn Station's main clock was sentimentally set at

The original East 7th Avenue façade showcased a sequence of pink granite columns.



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PHOTO COURTESY LIBRARY OF CONGRESS

Inspired by Roman Baths of Caracalla, the station's main waiting room is approximately the scale of St. Peter's nave in Rome.

10:53 to signal the opening date of the station, 1910, and its lifetime, 53 years. It would take three years to destroy and dismantle McKim's noble work. Only when Penn Station was gone did New Yorkers realize what they had lost. The ensuing Landmarks Preservations Law would eventually save Grand Central Station from a similar destruction.

Where once Penn Station had been a glorious gateway, now it had been reduced to an underground remnant. And so for the past decade there have been a variety of plans to re-establish Penn Station at the former U.S. Post Office across 8th Avenue, a McKim, Mead & White building that promises a return to former grandeur. Hopes wax and wane, and as of fall 2009, New York Gov. David Paterson asserts that the new Moynihan Station, to be named in honor of longtime U.S. Senator Daniel Patrick Moynihan, is back on track. ◀

Jill Jonnes is author of Conquering Gotham: Building Penn Station and Its Tunnels (Penguin), and Empires of Light: Edison, Tesla, Westinghouse and the Race to Electrify the World (Random House). Her current book is Eiffel's Tower: and the World's Fair Where Buffalo Bill Beguiled Paris, the Artists Quarreled, and Thomas Edison Became A Count (Viking Press).



Safety with Steam

Ignoring pressure or temperature ratings of hoses or couplings can be deadly

BY PHIL KIMBLE

Every good purchasing agent has an array of sources for the products necessary to keep his company's business running smoothly. Vendor catalogs are valuable tools that provide the experienced procurer with a wealth of information. This same information in the hands of someone not quite as seasoned can have dire consequences.

One department in a food processing plant was responsible for off-loading molasses from railroad cars. The rail cars need to be heated to get the molasses to flow, especially in the winter months. This heating process was accomplished by connecting a line from the plant's steam system to the rail car.

A new purchasing agent was looking for replacement heating lines. As he was looking through catalogs the solution crystallized. He sat back with a smile wondering why no one had come up with this before. Though the

catalog noted that the hose temperature maxed out at 200 degrees Fahrenheit and steam is 212 degrees, he believed that all manufacturers put a little 'fudge factor' in their numbers. Eager to impress his boss with the cost savings, he placed his order.

After reviewing an invoice for more of the new heating lines, the plant manager was getting concerned about how fast they were wearing out. Even with the cost savings, the new ones were actually more expensive because they had to be replaced so often. But his crew liked how easy they were to use. He was about to call the purchaser to discuss this when his phone rang. The panicked voice on the other end told him to get to the rail yard immediately—there had been an accident.

When one of the yard crew members disconnected the heating line from an empty car, he had forgotten to relieve

the pressure before disconnecting it. The line still had 90 psi in it when he released the coupling levers. The hose exploded from the car and the metal coupling struck the worker, killing him.

Pressure and temperature for saturated steam is directly related. In this case, 90 psi steam is actually 331 degrees F not 212 degrees. Hose and couplings designed for the rigors of steam service are the only ones that should ever be used. Not only is steam very hot, it is compressible. Sudden release is an explosively violent reaction that can carry deadly force.

Doing a little independent research does not make one an expert. Never exceed the maximum recommended pressure or temperature rating of either the hose or couplings. And remember, the assembly working pressure is always rated to the lowest rated component, hose or coupling. If in doubt, contact the expert: the manufacturer. Guessing can be a deadly game. ■

THE DIXON DRILLER

MARCH 2010

"Published once a moon since 1932"

TRIVIA Did you know that...

U.S. President Calvin Coolidge liked to eat breakfast while having his head rubbed with Vaseline.

The word 'News' is actually an acronym standing for the four cardinal compass points – North, East, West, and South!

The normal static electricity shock that zaps your finger when you touch a door-knob is usually between 10,000 and 30,000 volts!

To have your picture taken by the very first camera you would have had to sit still for eight hours!

It takes six months to build a Rolls Royce...and 13 hours to build a Toyota.

According to U.S. laws, a beer commercial can never show a person actually drinking beer.

Baskin Robbins once made ketchup ice cream.

When you walk down a steep hill, the pressure on your knees is equal to three times your body weight.

Jimmy Carter is the first U.S. president to have been born in a hospital.

A man named Charles Osborne had the hiccups for approximately 69 years.

The longest word in the English language is pneumonoultramicroscopicsilicovolcanokoniosis! [noomuh-noh-uhl-truh-mahy-kruh-skop-ik-sil-i-koh-vol-keynoh-koh-nee-oh-sis, nyoo-]

Definition: an obscure term ostensibly referring to a lung disease caused by silica dust.

ON THE LIGHTER SIDE

One day I was walking down the beach with some friends when someone shouted....

"Look at that dead bird!" Someone looked up at the sky and said...

"Where???"

Some guy bought a new fridge for his house. To get rid of his old fridge, he put it in his front yard and hung a sign on it saying: "Free to good home. You want it, you take it."

For three days the fridge sat there without even one person looking twice

at it. He eventually decided that people were too untrusting of this deal. It looked too good to be true, so he changed the sign to read: "Fridge for sale \$50." The next day someone stole it.

I was having trouble with my computer. So I called the computer guy to come over. The IT guy clicked a couple of buttons and solved the problem. He gave me a bill for a minimum service call. As the IT guy was walking away, I called after him,

"So, what was wrong?"

He replied,

"It was an ID ten T error."

I didn't want to appear stupid, but nonetheless inquired:

"An ID ten T error? What's that ... in case I need to fix it again?"

The computer guy grinned....

"Haven't you ever heard of an ID ten T error before?"

"No," I replied.

"Write it down," he said, "and I think you'll figure it out."

So I wrote out I D 1 0 T.

(<http://www.danggoodjokes.com>)

Dates in History

1790

On March 1, the first U.S. census was authorized. Since that first day in 1790, we have been counting heads to determine Congressional districts, to allocate government money, to figure out unemployment rates, and so forth.

1854

On March 7, 1854, Charles Miller of St. Louis, Mo., was granted a patent for the invention of a sewing machine that could stitch buttonholes.

1879

On March 14, Albert Einstein was born in Ulm, Germany. The man who is regarded as one of the world's great geniuses was not a particularly good student. Albert Einstein won the 1921 Nobel Prize in Physics for creating a tremendous revolution with his theory of relativity.

(Excerpted from On This Day in History)

1894

On March 22, 1894, the first championship series for Lord Stanley's Cup was played in Montreal, Canada. The Stanley Cup has since become one of the most cherished and recognized trophies in sport.

1938

On March 10, for the first time since they began in 1927, the names of Academy Award winners were kept secret until their announcement at the awards ceremony, which took place on this day in 1938.

1949

On March 17, 1949, the first car to carry the Porsche family name was introduced at the 19th International Automobile Show in Geneva, Switzerland.

(<http://www.history.com>)

Product Spotlight

SHARKBITE® PUSH-FIT FITTINGS

Dixon will be introducing a new Water Fitting called Sharkbite® Push-Fit Fittings in the 2010 Dixon Price List (DPL410) in April. This fitting can be used for water, dry clean air, or 100 percent glycol solutions and offers easy connection to copper, CPVC, and PEX in any combination.

The Straight Couplings connects tubing to tubing and when connected will not detach. Sharkbite® Push-Fit fittings are designed so that when connected to tubing the teeth inside will bite down allowing for a secure strong hold. No soldering, clamps, unions, or glue is needed; however fittings can be rotated after assembly for easier installation in tight spaces. Easy to disconnect if needed with use of a special clip.



The Straight Connectors are designed to connect a Female/Male National Pipe Thread to tubing. All Sharkbite® Push-Fit Fittings are certified to 200 PSI and 200F, and approved for use underground and behind walls without access panels. The material available is forged brass and are certified for potable water and hydronics.

In addition to having an integral tube liner for PEX installations, it's also design certified and listed to ASSE 1061/NSF 61, listed by IAMPO. The fittings also meet UPC, IPC, and cUPC requirements. Sizes range from 1/2" to 1", please call the factory at 800.355.1991 for further information.



Avoiding the Pain

Maintaining your fitness level can help ward off sports-related injuries

BY MARIA BLACKBURN

One minute you're kicking the soccer ball around with your kid or preparing to tee off for your regular Saturday morning game of golf, the next thing you know you're in agony. Pain is radiating from your knee or ankle or lower back. You aren't sure what happened. All you know is that you wish it would stop.

Adults age 25 and older sustain an estimated 2.29 million sports and recreational injuries every year, according to a recent U.S. National Health Interview Survey. The injuries were both chronic and acute, caused by rough contact sports like football or more staid individual sports like golf. Some were mild enough to be treated at home; others were serious enough to require a trip to the hospital.

Whatever the sport or the injury, one factor remains the same: As you age, your chances of getting a sports injury increase, especially if you continue to play at the same intensity that you did when you were younger, says Dr. Stephen Rice, a fellow with the American College of Sports Medicine who practices pediatric sports medicine at Jersey Shore University Medical Center in Neptune, N.J.

"As you get older, it's tougher to keep your body satisfied and happy. Some of the things like the cartilage in your knees and the way in which the disks in your back are composed, they lose some of their elasticity and vibrancy," Rice says. However, getting older doesn't mean you have to sit on the sidelines.

"There's no reason you can't be active, but it takes a little more diligence on your part to keep yourself flexible, strong and aerobically fit," he says. "You have to be a little more careful about maintaining a regular activity base so that you don't get injured."

Here's a brief look at some common sports injuries and what you can do to prevent them:

ANTERIOR KNEE PAIN

What happens: Repeated knee bending during sports causes friction between the underside of the kneecap and the outside bottom of your thigh bone and creates irritation, inflammation and eventually the breakdown of cartilage. "Anterior knee pain is probably the most common problem in sports,"

says Dr. Timothy E. Hewett, a fellow at the American College of Sports Medicine and director of the Sports Medicine Biodynamics Center at Cincinnati Children's Hospital Medical Center.

Prevention: "Work on your body mechanics to help build up your hip musculature and gluteus maximus to help get your thigh bone into proper alignment," Hewett says. "Doing exercises such as squats, wall sits and hip abduction exercises are the single best way to keep from developing anterior knee pain."

ANKLE OR OTHER LIGAMENT SPRAINS

What happens: A fall, sudden twist or blow to the body causes a joint to be pushed in one direction, forcing the ligament to move beyond its normal range and stretch or even tear. "Usually something causes the body to move in an unusual way and that causes a ligament sprain," Rice says. Ankle sprains, more than 1 million of which occur annually in the United States, are the most common form of ligament sprains, but

injuries to the knee's anterior cruciate ligament are also common.

Prevention: Learn how to land by improving your balance. "The single best thing to do to prevent ankle sprains is to improve your balance by doing single foot, single leg balance exercises," Hewett says. "Start off by balancing on one foot with your other knee at a 90-degree angle and work up to doing this exercise with your eyes closed and with the added difficulty of a balance board."

MUSCLE PULLS AND STRAINS

What happens: A muscle or tendon gets stretched beyond its limit and tears, causing symptoms ranging from mild discomfort to severe pain. Muscle strains in the thigh are often accompanied by a popping or snapping noise.

Prevention: Make time to maintain good flexibility, and try to stretch after an episode of activity when the muscles are already warm, Rice advises. "Flexibility is important because most of the

time you are going to tear a muscle when you are trying to stretch it to an extreme," he says. And always warm up before sports. "You reduce your chances of getting yourself into trouble if you are prepared properly for your activity."

LOW BACK PAIN

What happens: Your legs support some 60 percent of your body's weight and where they join your body at the lower back can be a source of muscle soreness. Participating in sports like golf that call for lots of twisting and turning can lead to overuse of muscles surrounding your spine and stomach and cause low back pain.

Prevention: "What we think with low back pain is that it's caused by weakness of the muscles that help stabilize the trunk and spine," Hewett says. Activating these stabilizers with exercises that strengthen your body's core muscles, such as abdominal crunches, can help prevent shifting of the spine that causes low back pain, he says. ■

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Pure Light

Developed with military objectives in mind, the laser is now a part of everyday life

BY LISA DE NIKE



Fifty years ago, the idea of using a slender, concentrated beam of light to scan supermarket groceries, play music, print documents, whiten teeth, remove unwanted body hair and even perform delicate eye surgery would have seemed like something straight out of a science fiction novel.

Today, however, we take lasers in their various forms almost for granted, giving little thought to the brilliant scientific and, as it turns out, legally tangled process that brought us these modern conveniences.

The story of the laser began, as do so many things in modern physics, with Albert Einstein, whose 1917 paper, “On the Quantum Theory of Radiation,” is said to have laid the groundwork for later work on the laser. Einstein posited that if certain kinds of atoms were mixed with radiation of the right wavelength, it would cause the release of more radiation of the same wavelength: a phenomenon that would basically double the strength of the wave.

This theory made sense to scientists, who imagined that such power might be eventually harnessed to accomplish certain tasks. But it wasn’t until after World War II—in 1948, to be exact—that work on such an invention began in earnest, when the U.S. Pentagon gathered and provided financial backing to a team of physicists at Columbia University.

On that team was Charles Townes, who came to New York from the

California Institute of Technology, where he had rubbed elbows with scientific luminaries such as Nobel laureate Linus Pauling and J. Robert Oppenheimer, scientific director of the U.S.-led Manhattan Project.

Townes and his team found that by stimulating molecules with microwaves, they could produce a pure, concentrated beam. In 1953, they designed a machine that did just that, the MASER, which stands for “microwave amplification by stimulated emission of radiation.” Townes then teamed up with Arthur Schawlow, his colleague at Bell Laboratories, who had ideas to contribute to the project. In 1959, the two men published a paper about their concept in *Physical Review* and were granted a patent for the invention of the laser (still called the “maser”) two years later.

Though it took some of the country’s greatest scientific minds to develop the laser, the concept behind the invention is pretty simple. While camping as a child, did you ever try to ignite a campfire using a magnifying glass to focus the sun’s rays on a pile of dry brush? If so, you were applying to the task of fire-building the same concept that makes a modern laser capable of such disparate tasks as cutting steel beams and reshaping the delicate tissues of the human eye.

In a nutshell, lasers work by bringing together and concentrating various wavelengths of light into one coherent beam. (In physics, “coherent” means that all of the various light beams’ energies—their

photons—are flowing in the same direction.) The result is a tool whose power can be varied for different tasks (from scanning groceries to improving eyesight) by altering the power source, the color of the lightwaves involved and even the source of light.

Interestingly enough, it wasn’t Townes who built the first working laser; that credit goes to Theodore H. Maiman of Howard Hughes Research Laboratories in Malibu, Calif., which had an Army Signal Corps contract to develop a laser (which stands for light amplification by stimulated emission of radiation), a maser that produced visible radiation, sometimes also called an optical maser. Maiman, who was familiar with Townes’ work, in 1960 invented a device that emitted a strong, ruby red light beam. It was a breakthrough, but still limited because Maiman’s model was only capable of pulsed operation. Later that same year, Ali Javan, an Iranian physicist, made the first gas laser, for which he won the 1993 Albert Einstein Award of Science.

In the end, the invention of the laser (which is now part of our everyday lives) was a collaborative effort, involving some of the giants of physics.

One wonders what they would have thought had someone told them that, someday, their hard-won invention would be used to scan gallons of milk, boxes of cereal and cans of tuna at their local grocery stores! ■



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