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An engineering wonder

BOSS

CONNECTING TO INDUSTRY

GOING FOR GOLD

THOUGH FEW EVER STRIKE IT RICH, THE LEGENDARY LURE OF THIS LUSTROUS METAL IS ENOUGH TO KEEP PEOPLE PANNING FOR PAY DIRT THE WORLD OVER

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TIMELESS VALUES

If you turn to page 30, you'll see a picture of my grandfather, Howard W. Goodall.

This photo was taken during the construction of Hoover Dam, about 15 years after he started Dixon. He enjoyed designing hose couplings for many industries, with construction being a main outlet. Thus, the building of Hoover Dam offered him a prime opportunity to network in the construction market.

H.W. was a very interesting fellow. He only had an eighth-grade education (not uncommon in the early 1900s), but he clearly had a knack for business. In fact, he ended up owning the company that gave him his first job. Once he launched Dixon, he would spend many weeks in a row calling on customers at job sites, where he would collect ideas that he used to improve Dixon's offerings.

A man of strong personal integrity and business values, Howard W. Goodall set the tone that is still paramount to Dixon nearly 100 years later. Much has changed over the decades but H.W.'s founding commitment—of working closely with distributors and understanding end users' requirements—is alive and well at Dixon, the same today as back when Hoover Dam was being built.

Well-designed hose couplings and superior customer service remain crucial to Dixon's success. But H.W.'s most enduring legacy is his imprint on the company's core values.

Thanks for reading,

Dick Goodall

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SUMMER 2015

ASIA/PACIFIC – WINTER 2015

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BOSS is produced three times a year by Dixon Valve & Coupling Company and Mid-Atlantic Custom Media. The acceptance of advertising does not constitute endorsement of the products or services by Dixon Valve & Coupling Company. The publisher reserves the right to reject any advertisement that is not in keeping with the standing or policies of Dixon Valve & Coupling Company. Copyright 2015, all rights reserved. Reproduction of any part of BOSS without written permission is prohibited.

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ON THE COVER

South Africa, Randfontein, 1997: Randfontein

Gold Mine Photo credit: Graeme Williams

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Just Ask Your Grandmother

> Huge companies have been brought down by massive dishonesty, irresponsible debt and shameless self-dealing. The more we learn about these situations, the more likely we are to conclude that moral compromise is an integral part of corporate life.

It seems that lying is simply a necessary tactic for executives driven on the one hand by a lust for vast rewards, and on the other by an abiding fear of losing their place at the table. And, lower down in the corporation, it seems many workers just want to keep their jobs, so they do what they're told.

It's doubtlessly true that in some companies it is really hard to consistently do the right thing. But temptation is not moral ambiguity. Today's executive can go through hundreds of pages of laws and spend hundreds of thousands of dollars on lawyers and accountants to find ways to justify conduct that every grandmother knows is flat-out wrong.

The greatest defense against scandal and disgrace is not an army of lawyers and accountants but simple integrity. Just be honest! Don't make this more difficult than it is. White lies may be acceptable, trading off honesty for kindness in certain social situations (e.g., telling your wife she doesn't look a day older, or your husband that you love the ugly sweater he bought), but

don't use these examples to justify self-serving business lies to inflate profits, conceal problems or evade laws.

I challenge you to think of a situation where it's ethical to lie for a business purpose. And by the way, clever deceivers are no better than liars. Ask your grandmother.

There's more to life than profits and promotions. For the sake of your family and your peace of mind, don't let the cynics convince you that honest people can't survive in business. In fact, the way things are going, integrity is likely to be

the most treasured quality in the next decade. ●

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“The greatest defense against scandal and disgrace is not an army of lawyers and accountants but simple integrity.”

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Pastor, Martyr, Spy

Bravely standing up to the Nazis in his German homeland, Dietrich Bonhoeffer paid the ultimate price

> In April 1945, as the Allies pinched the battered Third Reich from both the East and the West, Dietrich Bonhoeffer sat in a Nazi prison camp.

A leading theologian, the 39-year-old Lutheran pastor had vocally opposed Adolph Hitler and his regime from its earliest days. In a radio address soon after Hitler's rise to power, Bonhoeffer had passionately warned his homeland against blindly idolizing the Führer ("leader"). He predicted that Hitler would instead turn out to be *Verführer*—a misleader or seducer. In the ensuing years, through his influential writings and his sermons, Bonhoeffer became a leading voice in the Nazi resistance.

Now he would pay the ultimate price. At dawn on April 9, 1945, he was awakened, stripped naked and led to the hangman's noose, all the while

exhibiting a peace that impressed his prison guards. "This is the end, for me the beginning of life," he had famously uttered just a few days earlier.

Two weeks after Bonhoeffer's execution, the Allies liberated the prison at Flossenbürg. A week after that, Hitler committed suicide.

Even as a child, Dietrich Bonhoeffer exhibited a deep religious faith—all the more notable since his family wasn't particularly devout.

Growing up in Berlin with six other siblings, young Dietrich took his share of ribbing. When his older brother Klaus taunted him by saying that the church was "a poor, boring, feeble, petty bourgeois institution," Dietrich confidently responded: "In that case, I shall have to reform it!"

In 1924, at age 18, Bonhoeffer journeyed to Rome to further his faith. He spent the next years back in Germany pursuing theological studies, and then traveled to the United States for postgraduate work at Union Theological Seminary in New York. While teaching Sunday school in Harlem, he developed a lifelong love for African-American spirituals—and a



picture-alliance/dpa/Newscom

Dietrich Bonhoeffer (undated photo)

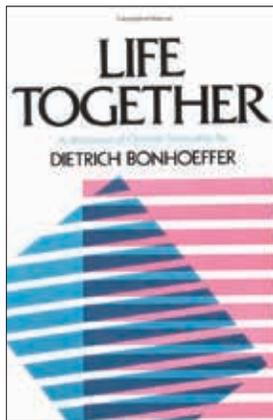
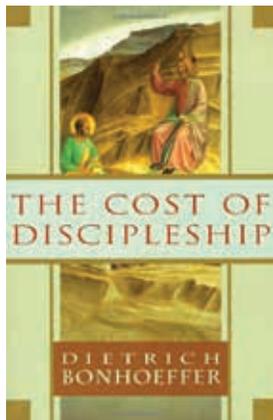
newfound empathy for those suffering oppression.

Back in Germany, Bonhoeffer grew increasingly alarmed by Hitler's rise to power. He was especially appalled at how easily the German Lutheran Church gave in to the Nazi supremacist agenda. In April 1933, he bravely implored the church to oppose Hitler's persecution of the Jews, declaring that the church must not simply "bandage the victims under the wheel, but jam the spoke in the wheel itself."

Bonhoeffer became active in the rival Confessing Church, which disowned the "official" state-sanctioned Lutheran church in Germany. As the snow melted in the spring of 1935, he began work at an underground Confessing Church seminary in Finkenwalde—a position he held until the Gestapo shut it down.

During these years, Bonhoeffer risked his life by publicly opposing the Nazis' stranglehold on faith and Lutheranism, even as many other Aryan intellectuals toed the party line. He also penned two of his most influential works: *The Cost of Discipleship* (which remains a classic Christian text today) and *Life Together*.

Two of Bonhoeffer's most influential works: *The Cost of Discipleship* and *Life Together*



Hoping to build international support, Bonhoeffer left for the United States in June 1939, but soon regretted his decision. "I must live through this difficult period in our national history with the people of Germany," he wrote to friends. Though returning would put him at grave risk, he took the last steamer scheduled to cross the Atlantic before World War II.

Convinced that Hitler himself must be stopped, the gentle pastor began working with anti-Nazi conspirators in 1940. For cover, he joined a German military intelligence organization, posing as a Nazi agent while secretly drumming up support for an anti-Hitler conspiracy through visits to other countries.

Eventually, Bonhoeffer's association with the German resistance caught up

with him, and he was sentenced to Tegel Prison, Berlin, on April 5, 1943. Collared for minor offenses, he fooled his interrogators into thinking he knew nothing of any deeper conspiracy. Over

the next 18 months, he continued to write (his *Letters and Papers from Prison* would be published posthumously) and correspond with his fiancée.

But then came a failed plot on Hitler's life, on July 20, 1944—popularized in the film *Valkyrie*. In the aftermath, Bonhoeffer's connection with the conspirators was discovered. In February 1945, he was clandestinely

moved to the Buchenwald concentration camp and then to Flossenbürg, where he was condemned to death.

Though Bonhoeffer died young, his teachings would go on to have a lasting

"Silence in the face of evil is itself evil. Not to act is to act."

influence, inspiring Martin Luther King Jr. and the civil rights movement, the anti-communist democratic movement in Eastern Europe and the anti-apartheid movement in South Africa.

"Silence in the face of evil is itself evil," Bonhoeffer famously wrote. "God will not hold us guiltless. Not to speak is to speak. Not to act is to act." ●

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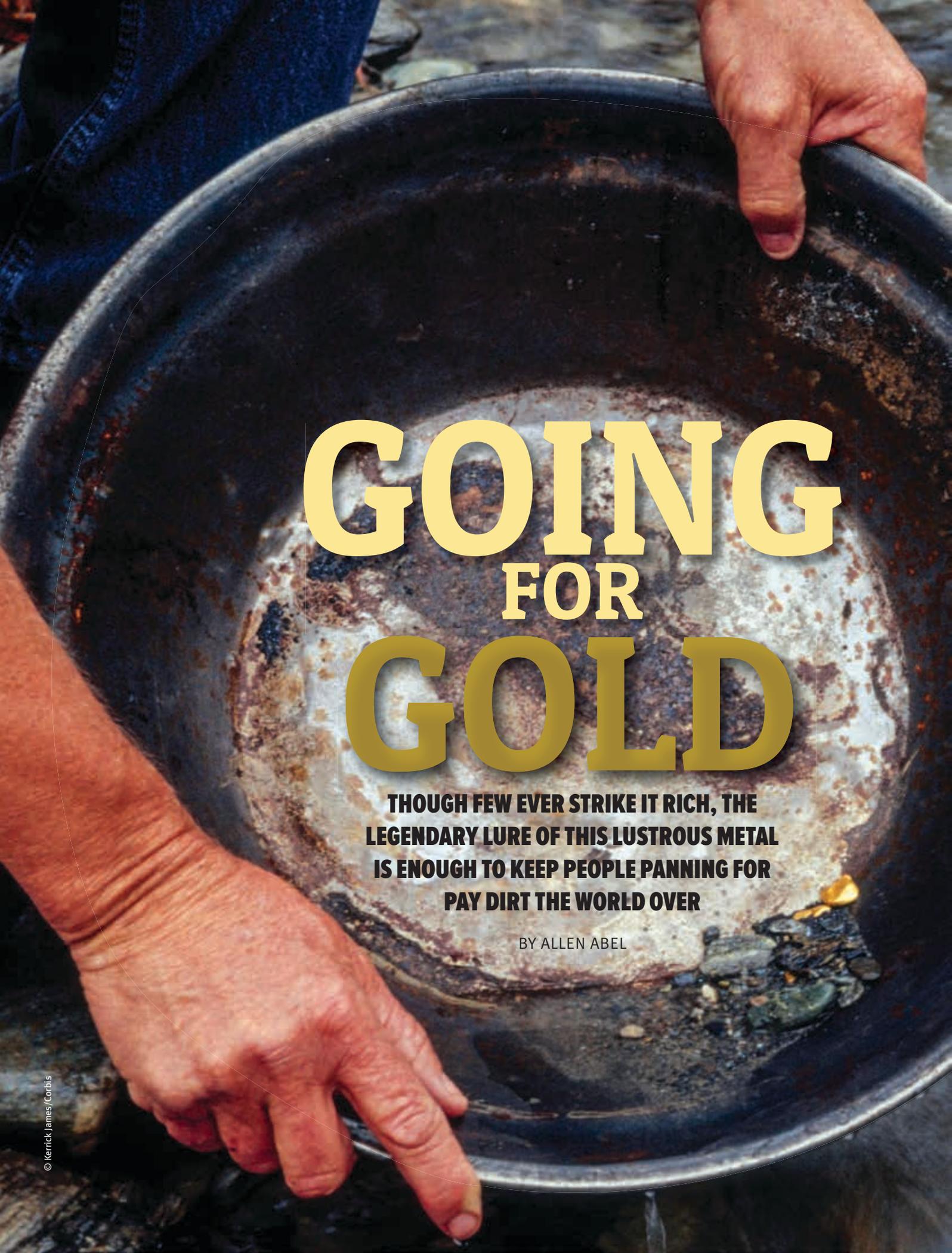
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The Right Connection®



GOING FOR GOLD

**THOUGH FEW EVER STRIKE IT RICH, THE
LEGENDARY LURE OF THIS LUSTROUS METAL
IS ENOUGH TO KEEP PEOPLE PANNING FOR
PAY DIRT THE WORLD OVER**

BY ALLEN ABEL



Aerial views show the Grasberg open pit mine, in Indonesia's Papua province. The mining operation is run by the U.S.-based Freeport McMoRan Corp.

HAVING cut his teeth in the gold mining industry in western Australia, Andrew Prentice had been exposed over the years to many large operations in isolated locations. But nothing prepared him for what he found atop a remote mountaintop in West Papua, Indonesia.

The Grasberg mining operation there, run by Freeport McMoRan Corp., is so massive that its human-hewn mile-wide crater can be seen from space.

"I was in awe," recalls Prentice, managing director for Dixon Asia Pacific, who made the trip to provide technical and sales support for Dixon products used in mining. "With nearly 20,000 employees living and working in such a remote location, the operation resembles managing a small city on the top of the highest peak you can imagine—4,300 meters (14,000 feet) in the air, amongst glaciers and thick rain forest."

Life for those working at Grasberg isn't easy, as Prentice and his colleagues discovered during their multi-day stay. "We experienced all aspects of living and working in such a remote and rugged location," he says. "We witnessed a large earth tremor, somewhere around 7 on the Richter scale, several landslides and also felt firsthand the near freezing conditions at the Grasberg open-cut mine at the top of the peak."

But for those toiling away in the mines at Grasberg, the lure of the gold buried there would seem to outweigh the risks and hardships. It's been that way since the first gleaming flake of gold was discovered.



"Gold" ©iStockphoto.com/Goruppa



Miners pose for a photograph near Nevada City in California during the Gold Rush.



Miners with pneumatic drill working in one of the Crown Gold Mines in Johannesburg, South Africa, c. 1930.

everything from Oscar statuettes to Olympic medals to the delicious Indian dessert called burfi. It's worth noting, however, that 78 of every 100 ounces that are taken from the ground are used to make jewelry.

Gold Diggers

The process of discovering, extracting and refining gold is as old as the pharaohs, with some modern twists. The atomic weightiness of gold is the basis for "placer" mining, which, in its basic form, entails nothing more than swishing sand from a riverbed with some water in a pan and waiting for the particles of gold to settle to the bottom or "pan out."

But the world is far too hungry for gold to be content with a few grains from sloshings. On an industrial scale, gold production involves massive operations in city-sized open pits and vast underground tunnels in some of the world's most remote and inaccessible corners, using machinery that can shovel, truck, pipe, crush and

To obtain the estimated 171,000 metric tonnes (377,000,000 pounds) of gold that have been unearthed over the past 5,000 years, muckers and mushers have frozen to death in the Klondike, panned for pay dirt in muddy streams from California to the Congo, ravaged the great civilizations of pre-Columbian America and scraped bare the summits of forbidding mountains from Papua to Peru ... all in search of El Dorado.

A very, very few struck it rich. Many more were crushed in cave-ins, drowned in torrents or shot down in cold blood by rival prospectors.

Yet the Gold Rush never ended. It never will. The lust is as strong today as

it ever has been, with billions and billions of people of every nation, tribe and social stratum laying claim to at least a gold chain, a gold bracelet, a gold necklace or a few shares of gold-mining stock.

Of course, all that glitters is not gold, Shakespeare sagely said. But all that is gold does glitter, forever—it never rusts, corrodes or fades. Gold conducts electricity perfectly, is nonpoisonous and edible, can be hammered and drawn into sheets and wires only a few atoms thick, and has been minted as coinage since the days of King Croesus of Lydia in the sixth century B.C. It can be used to gild



PRODUCT SPOTLIGHT

DIXON SUPPORTS THE GOLD MINING INDUSTRY WITH A VARIETY OF PRODUCTS:

Mining: Boss fittings, cam and groove, valves, shank and water fittings, pipe and welding, clamps and hydraulic fittings.



convey hundreds of thousands of tons of raw ore every day.

At Grasberg, the largest gold production operation in the world, there are more than 500 km (310 miles) of underground tunnels to support production and operations, notes Prentice. For workers traveling from the mid-mountain town of Tembagapura up to the open-cut mine, the daily trip to work is arduous, requiring a long drive up the mountain, through underground tunnels and along treacherous dirt roads. “Some folks even take a cable car from the processing plant to the mine site to begin work each day,” he says.

The key to liberating gold from its less lustrous companion minerals is the infamous and deadly chemical cyanide, an 18th-century discovery that first was put to practical use in South African mines in the 1890s. Most commonly, a solution of sodium, potassium or calcium cyanide is used to dissolve gold out of crushed rock, producing a muddy pulp that then is treated at high heat with carbon or zinc and hot water to leach or precipitate the precious metal.

Further refining takes place at a smelter where a witches’ brew of chemicals is added to the gold precipitate and heated to more than

The key to liberating gold from its less lustrous companion minerals is the infamous and deadly chemical cyanide, an 18th-century discovery that first was put to practical use in South African mines in the 1890s.

2,900 degrees Fahrenheit. Impurities are poured off, and the process is repeated until only molten gold of 99.99 percent perfection remains.

Depending on the market price of gold, a concentration of as little as one gram of pure gold per ton of rock can make the entire operation profitable. But while bars of glowing bullion are being stacked in vaults and sculpted into ornaments, the leftovers of the extraction—millions of tons annually of sand, stone, cyanide, mercury and a myriad of other friendly and/or hazardous chemicals—need to be neutralized and bulldozed into man-made Himalayas of dross.

A Steep Price

No nation is more manic for gold than India, although it has its rivals. In Calcutta, generations of impoverished dust-sweepers called Newaras, some as young as 12, whisk the pavements of the jewelry district at dawn, gathering enough specks to sell for a dollar or two to sustain themselves for another day.

In South Africa, the world’s sixth-largest producer of gold in 2013 (trailing China, the United States, Russia, Australia and Peru, but ahead of Canada, Mexico, Uzbekistan and Ghana), desperately poor “zama-zama” miners risk their lives to sift through the

A worker watches a lift that he is controlling while a giant dry grinding ball mill spins behind him in Mill 6 at Newmont Mining’s Carlin gold mine operation near Elko, Nevada, on May 22, 2014. Right: Molten gold is being poured into ingots.





MUHAMMAD YAMIN/REUTERS/Newscom



MUHAMMAD YAMIN/REUTERS/Newscom

Aerial views of the Grasberg Mine

dust of abandoned, crumbling pits and shafts. But it gets worse: Around Johannesburg, thousands of illegally trafficked “gold boys” toil deep underground in brutally enforced slavery, digging, hauling, crawling and dying for the ore that feeds the world’s insatiable appetite for the precious metal.

To a few lucky souls, the mother lode comes much more easily. In 2013, an amateur Australian prospector waved a metal detector at a patch of dirt in the state of Victoria and discovered a 12-pound nugget worth more than \$200,000.

But of all the “Them thar’ hills” that have made a Midas out of ordinary

men, none can match the snow-crueted equatorial peak named Mount Carstenz in Indonesia. It was there, in 1936, that a party of Dutch climbers found themselves 14,000 feet above sea level on a tropical alp abundantly rich in copper ore and its geological fellow traveler, pure gold.

Today, the operation known as the Grasberg Minerals District—which Andrew Prentice visited—is mined by Freeport-McMoRan, headquartered in Phoenix, Arizona. From this largest gold reserve in the world, PT Freeport Indonesia extracted more than 1 million ounces of gold in 2013.

In some ways, the crushing, sorting, shipping and smelting of ore that Freeport does today is easy, compared to the early engineering challenges posed by Grasberg.

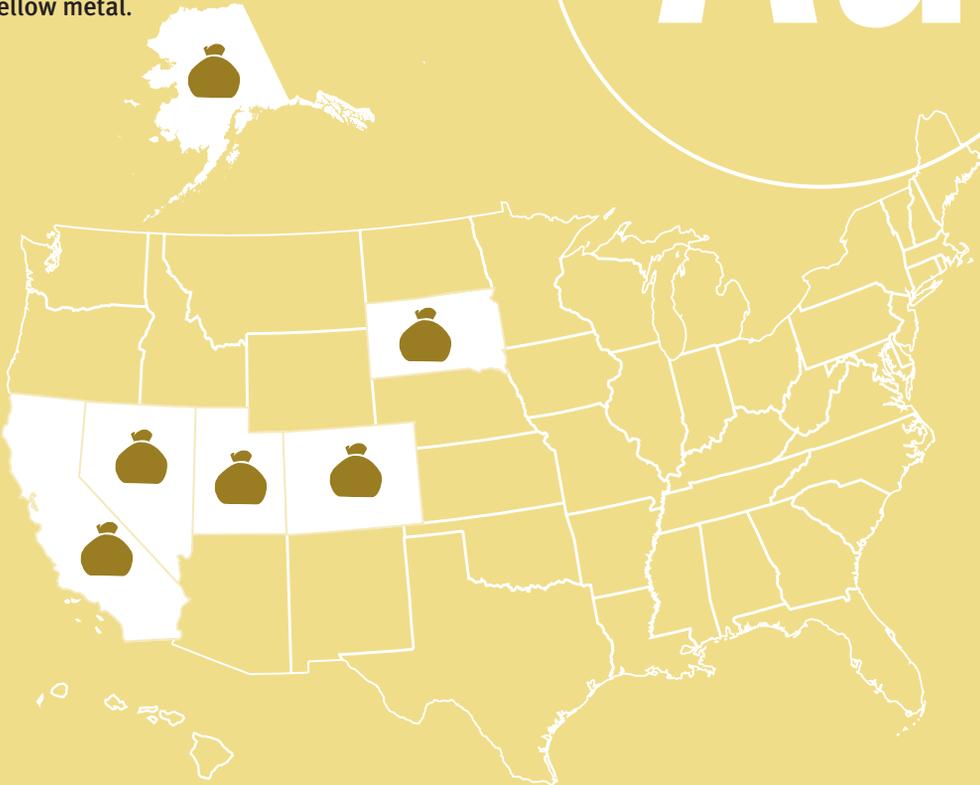
Grasberg is 63 miles from the Arafura Sea, yet in such altitudinal isolation that there was not even a rough track hacked to the mountaintop before the Dutch arrived. It took 17 days for Freeport engineers to safari to the site in 1960 in a region so

STATES OF GOLD

Today...

Data by state shows that most U.S. gold production takes place in Nevada and Alaska. Utah and Colorado are close followers, and South Dakota and California are also significant sources of the yellow metal.

Au



...and Yesterday

North Carolina: 1799

Conrad Reed finds a 17-pound “glittering stone” in Little Meadow Creek, Cabarrus County, on his father’s farm. By 1804, the Carolina Gold Rush is underway.

Georgia: 1828

The nation’s second gold rush starts in present-day Lumpkin County and soon spreads through the North Georgia Mountains.

California: 1848

Gold is first discovered by James Marshall, setting off the California Gold Rush that would draw gold-seeking “49ers” from across the U.S. and around the world.

Colorado: Late 1850s

The Pike’s Peak Gold Rush in Colorado signals the first major push into the Rocky Mountains.

South Dakota: Late 1870s

Gold discoveries in the Native American territory in the Black Hills of South Dakota start a new gold rush in the late 1870s.

The quest to find the next Grasberg is one of our planet's most lucrative, frustrating and blood-stirring pursuits. "There's no one to ask the way to go—you can only ask the rock," says IAMGOLD's Craig MacDougall.

far removed from the industrialized world that, according to corporate lore, one engineer was able to trade a metal hammer to a local chieftain for the right to build a helicopter landing pad.

The first challenge was to build a nearly vertical freeway to Grasberg—75 miles of hell from the quicksand of the mangrove swamps to the snows

and ice of the peak; "the toughest road-building project attempted anywhere in the world," in the words of George A. Mealey, former president of Freeport.

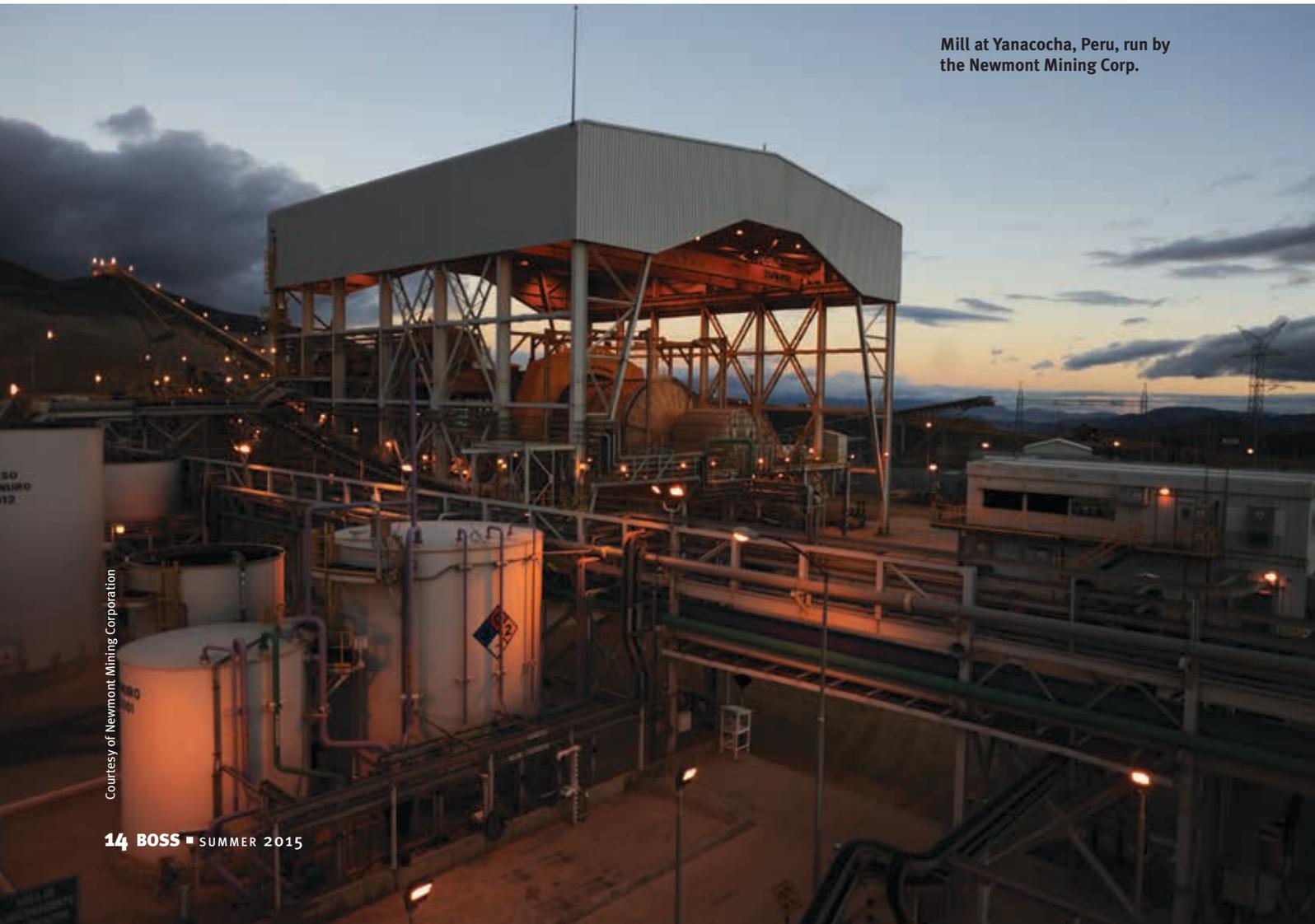
Then came the largest aerial tramway in the world, an entirely new city to house thousands of workers, containment ponds, heavy-machinery yards, training facilities and a pipeline

to carry 240,000 tons of concentrated ore a day back down the mountain to a new port on the coast.

Today, the Grasberg Minerals District encompasses three operating mines: the Grasberg open pit (where operations are expected to continue through 2017), the DOZ underground mine and the Big Gossan underground mine, a tabular, near vertical ore body.

Prentice's work at the massive operation—which took him on site surveys throughout Grasberg's mining, production, processing and power generation departments—was aimed at identifying opportunities to improve productivity and operator safety through the correct selection and use of Dixon products (See box, p. 10). "Through our local distributor in Indonesia," he explains, "Dixon supplies a wide range of products to the site—from hose couplings, clamps and valves used in underground production to petroleum handling equipment used to

Mill at Yanacocha, Peru, run by the Newmont Mining Corp.



fuel trucks, along with fire protection products used at the mine and also the township.”

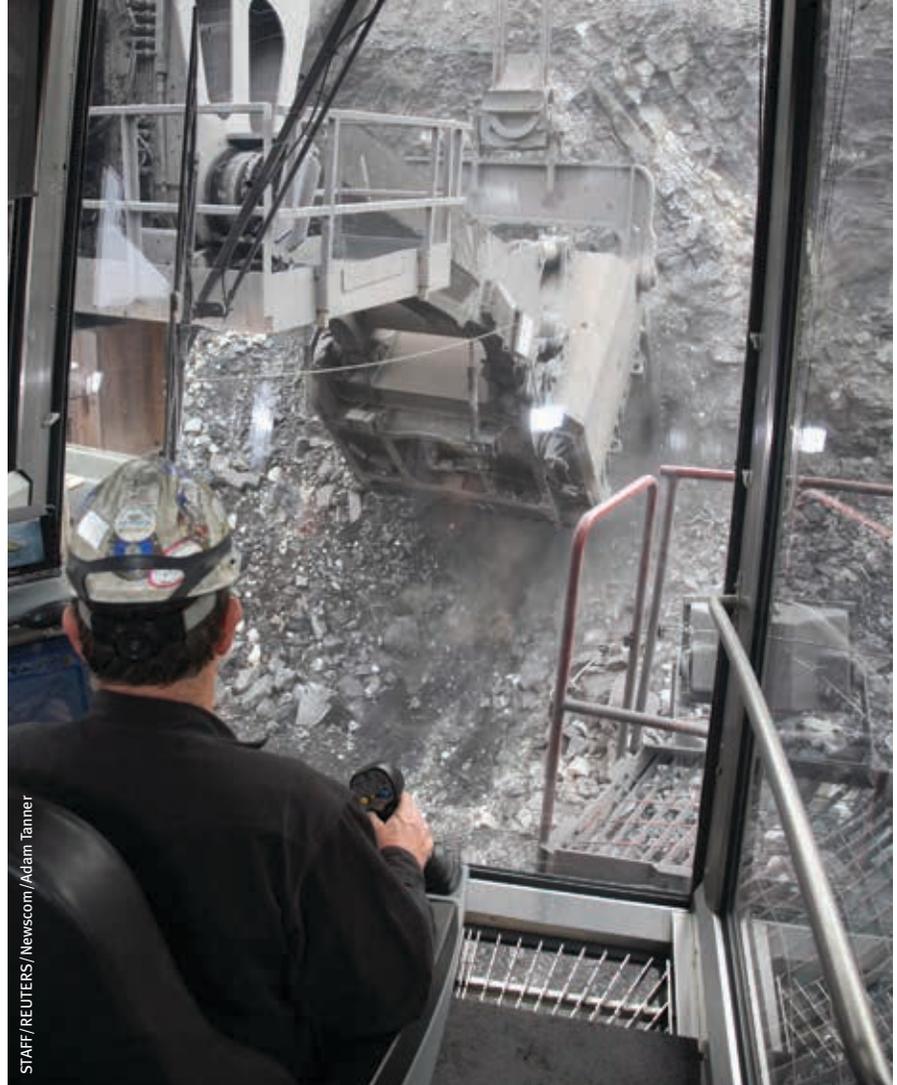
Of course, Grasberg isn't the only gold mining operation with notable production. The second-largest gold mine in the world—Yanacocha, Peru—is run by the Newmont Mining Corporation of Colorado, which has extracted more than 20 million ounces of gold since the 1980s. In third place is the Goldstrike complex of open-pit and underground mines in northeastern Nevada. The Barrick Corporation of Toronto reported in 2013 that at least 12 million ounces of gold remain to be extracted from Goldstrike.

This will hardly be enough to satiate the universal hunger for gold. The quest to find the next Grasberg is one of our planet's most lucrative, frustrating and blood-stirring pursuits.

“It's a game where you're the ultimate detective,” says Craig MacDougall, senior vice president of exploration at Toronto-based IAMGOLD. “There's no one to ask the way to go—you can only ask the rock.”

IAMGOLD, which operates mines in Surinam, Burkina Faso, Mali and the Canadian province of Quebec, took its name from the self-description of King Musa I of Mali, the real-life Midas of the 14th century. Accompanied by tens of thousands of gold-liveried slaves, Musa decamped for Cairo and Mecca with a flotilla of camels burdened down with gold. He gilded the villagers he met with 24-karat dust.

“We still do a lot of boot and hammer work,” MacDougall says. “We still send guys into the field to look at things and take samples. That's been a mainstay since the Klondike days. We



A miner operates an \$18 million mining shovel to remove rock and dirt from an open-pit mine at the Goldstrike Mine in northeastern Nevada, the most productive gold mine in U.S. history.

still rely on local knowledge—in West Africa, we go where the local people are actively mining, or we ask them to show us the old areas where their people used to find gold.

“These people have so little available to them that they will do everything from raising crops to panning every flake of gold out of the Sahara just to survive. They will do some very dangerous things for literally

one flake of gold. It's been going on like this for centuries, which is strange for a metal where we still have every ounce that has ever been minted. It doesn't rust, it doesn't wear out, but we still want to find more and more.

“In the eyes of a layman, you just pick up a rock and look to see if it's



INSECT ALLIES

Gold prospectors of the 21st century have unsuspected allies. In 2012, an Australian entomologist named Aaron Stewart published research showing that termite nests located close to known underground concentrations of gold ore displayed higher concentrations of gold than nests farther away.

It turns out that some species of termites and ants are able to accumulate the zinc and magnesium that they need to solidify

their exoskeletons, and to excrete the useless and no-good gold and silver that mess up their body chemistry.

“Drilling is expensive,” Stewart says.

“If termites can help narrow down the area that needs to be drilled, then exploration companies could save a lot of money.”

“Termite” ©iStockphoto.com/defun

BY THE NUMBERS

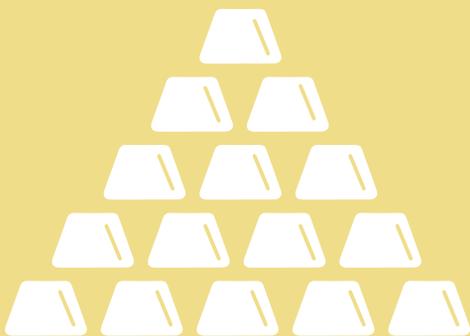
Super Pit, Australia's largest open-cut gold mine.



©iStockphoto.com/VaareRinne

TOP GOLD-PRODUCING COUNTRIES IN 2013

- China/mine production: 420 MT (metric tons) **1.**
- Australia: 255 MT **2.**
- United States: 227 MT **3.**
- Russia: 220 MT **4.**
- Peru: 150 MT **5.**
- South Africa: 145 MT **6.**
- Canada: 120 MT **7.**
- Mexico: 100 MT **8.**
- Uzbekistan: 93 MT **9.**
- Ghana: 85 MT **10.**



SOURCE: <http://goldinvestingnews.com/43146/2013-top-gold-producing-countries.html>



TOP 10 GOLD RESERVES IN THE WORLD

- #1 GRASBERG**
106,231,000 oz gold
Papua, Indonesia
- #2 SOUTH DEEP**
81,413,000 oz gold
Near Johannesburg, South Africa
- #3 LIHIR**
64,100,000 oz gold
Niolum (aka Lihir) Island, Papua New Guinea
- #4 MURUNTAU**
50,000,000 oz gold
Kyzyl Kum Desert, Uzbekistan
- #5 OLYMPIADA**
47,500,000 oz gold
Central Siberia, Russia
- #6 OYU TOLGOI**
46,340,000 oz gold
South Gobi Desert, Mongolia
- #7 PUEBLO VIEJO**
40,085,000 oz gold
Dominican Republic
- #8 MPONENG**
39,557,000 oz gold
Near Johannesburg, South Africa
- #9 CADIA EAST**
37,600,000 oz gold
New South Wales, Australia
- #10 OBUASI**
29,830,000 oz gold
Ghana, Western Africa

Source: <https://www.goldrushexpeditions.com/mining-com-reveals-the-worlds-top-10-biggest-gold-reserves/>



Excavator parked in an open-cast pit at change of shift

shiny,” MacDougall says. “But when you use the analytical techniques of science, you can discern very subtle differences. We take all kinds of measurements and do geochemical sampling beyond just assaying for gold content. We look at alteration assemblages, do microscopic work—look at different characteristics of the trace element geochemistry.”

The Search Goes On

After 5,000 years of digging, sifting, panning and praying, golden-eyed dreamers in 2015 find a market as wide open today as it was in the days of Solomon, Midas and Tut. The Centre for Economics and Business Research reported in December 2014 that more than one-third of mining jobs stay

unfilled for three months or longer, due to a shortage of highly trained personnel.

“This industry has a lot of different players,” says MacDougall. “Some are professionals; some are dreamers. There will always be a certain amount of cowboy and swashbuckling, and at the other end of the spectrum, people understand that if you run your business on good, solid fundamentals, you can build a successful company for the long term.”

“All the gold which is under or upon the earth is not enough to give in exchange for virtue,” wrote Plato, but few have heeded his words. From the Andean foothills to the mountaintops of Indonesia, the immemorial search goes on. ■

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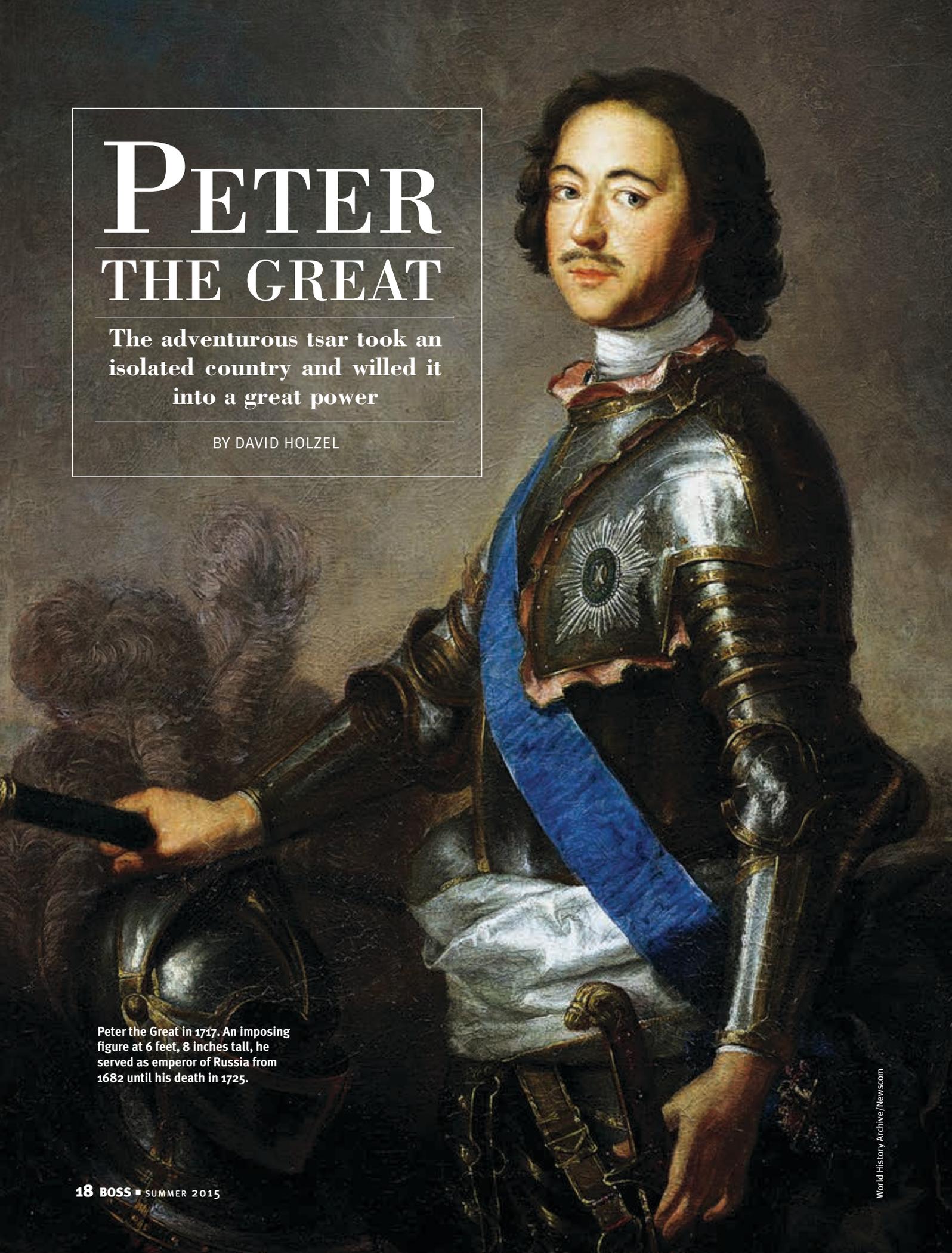


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PETER THE GREAT

The adventurous tsar took an isolated country and willed it into a great power

BY DAVID HOLZEL



Peter the Great in 1717. An imposing figure at 6 feet, 8 inches tall, he served as emperor of Russia from 1682 until his death in 1725.

The storehouse had been locked for years. That only made the question of what was inside more tantalizing to 16-year-old Peter Alekseyevich Romanov. He and his companions broke in, and in the misty gloom, Peter—tsar of Russia—found an old boat about 20 feet long, its timbers rotting.

Long forgotten on this royal estate outside Moscow, the vessel, so different from the riverboats that plied Russia's inland waterways, ignited the teenager's fierce curiosity. Could it be repaired, he asked one companion, a Dutch trader who was the young tsar's makeshift tutor. The Dutchman believed it could.

In 1688, when this story took place, Russia's foreign residents were restricted to "the German suburb" outside Moscow. There, the old Dutch trader found another countryman, a carpenter, who repaired the boat, fitted it with masts and sails and took it on rollers to a nearby river.

And so on an early summer day, Peter saw a boat tack against the wind for the first time. Soon he was learning from his Dutch teachers how to handle the vessel himself. "And mighty pleasant it was to me," he later wrote.

That boat opened up the world for a teenager of boundless energy who was looking to escape the cramped and bloody world of politics in Moscow. It led the young tsar to the sea, to Western ideas and the creation of the Russian navy. In the process, Peter the Great, as he was called by the end of his reign, recreated Russia, turning a vulnerable, inward-looking land into a great, expansive European empire.

Isolated and Vulnerable

For people of our time, who only know Russia as the largest country on Earth, a superpower or a force to be reckoned with, a European country on the far east of the continent and a place where, for so long, the individual counted for less than the state, the Russia that Peter was

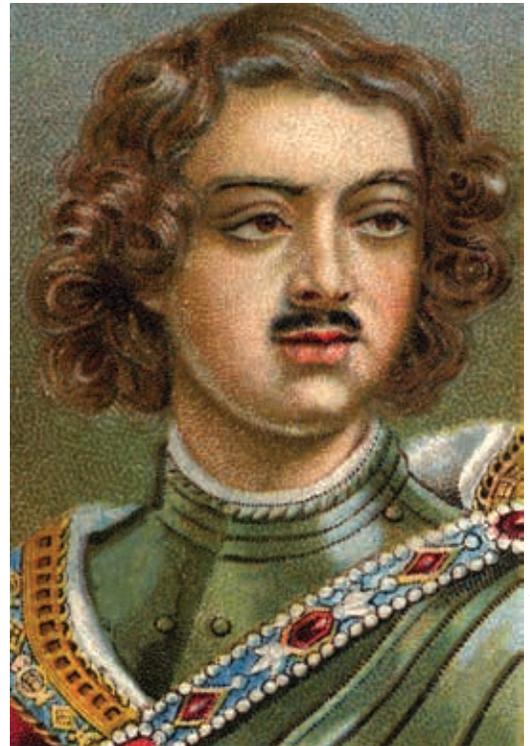
born into on June 9, 1672, can seem about as alien as the moon.

"Russia was an empire of villages, a collection of simple log houses centered on a church whose onion dome gathered up the prayers and passed them along to heaven," writes Robert K. Massie in his biography *Peter the Great*.

At the time of Peter's birth, Russia had a population of 8 million, about the same as contemporary Poland. While the tsar was known as the absolute ruler, Russia's Orthodox Church, which traced its authority to the Greek Orthodox Church of Constantinople, was more powerful. The state barely touched life in the village. The Church, in its quest for purity, isolated Russia. The Russia of Peter's birth was defensive and inward looking, as it strove to exclude foreign influences and heretical thoughts.

If Russia was, according to the Orthodox Church, spiritually vulnerable, it also was a land surrounded by powerful physical enemies—Turks, Poles, Lithuanians and Swedes. Its vast grasslands provided no natural defenses. Russia, whether from the religions or armies of Europe and Asia, was always under attack.

In 1676, when Peter was 4, his father, Tsar Alexis, died, and the crown passed to Peter's 15-year-old half-brother,



World History Archive/Newscom

A chromolithograph captures Peter the Great in his younger years.

Feodor. A sickly youth, Feodor died in 1682. Peter was named tsar—he was robust and lively, unlike another older half-brother, Ivan, who was passed over. Ivan's mother's family feared the loss of power would bring ruin to them and revolted. They were supported by the *streltsy*, "the shaggy, bearded pike men who guarded the Kremlin and were Russia's first professional soldiers," as Massie describes them.

In the Kremlin, the citadel that was home to the tsar and the Orthodox patriarch, the *streltsy* massacred the relatives and supporters of Peter's mother, hacking them to death as the 10-year-old watched. The political

That boat opened up the world for a teenager who was looking to escape the cramped and bloody world of politics in Moscow. It led the young tsar to the sea, to Western ideas and the creation of the Russian navy.

The streltsy revolt marked Peter for life. From then on, the tsar had a loathing of the Kremlin, Moscow, the Orthodox Church and the ancient rites of the Moscow nobility.

outcome was that, in 1682, Ivan was crowned co-ruler with Peter. Power shifted to Ivan's sister Sophia (Peter's half-sister), who was proclaimed regent.

An Extended Adolescence

The streltsy revolt marked Peter for life. Biographer Massie writes that from then on, the tsar had a loathing of the Kremlin, Moscow, the Orthodox Church and the ancient rites of the Moscow nobility.

Peter's mother removed him and a younger sister to a small estate outside Moscow. Meanwhile, in the capital, half-sister Sophia ruled, while half-brother Ivan carried out the formalities required of a tsar. Peter only returned to the capital for state occasions. Otherwise, Peter began an extended

adolescence, shunning most of the responsibilities of royalty but taking advantage of its perks.

Answering to no authority, he was free to follow his interests, and he mastered skills and areas of knowledge that touched his boundless curiosity. He befriended foreigners and learned of the world outside Russia. His favorite childhood game was war.

Peter began attracting and welcoming boys his age to his play army. Boys of low birth were embraced alongside the sons of nobility, whose families saw an association with the young tsar as good for their fortunes. But Peter was not a boy who jumped to

playing general. Following a pattern he often used when trying to master a skill, he entered his regiment as a drummer boy, and promoted himself only when satisfied he had met the requirements of a higher rank.

In this way, Peter challenged the old Russian ways of doing things. "From the beginning, Peter set this example," according to Massie, "degrading the importance of birth, elevating the necessity for competence."

As Peter grew older, the war games grew more elaborate, with imposed discipline and live ammunition. His army spent a year building a fort of earth and timber and then bombarded it, to see if they could knock it down.

Technical knowledge for Peter's "army" came from foreign officers in the German suburb. It was there—among the pipe-smoking Dutch, Germans and Scotsmen—that he learned to enjoy alcohol. Just as he was indefatigable in building a boat or constructing a fort, Peter took to drinking with gusto and good humor. Still in his teens, he established the Drunken Synod,

A 1717 painting by Jean-Marc Nattier depicts the Battle of Poltava, in which Peter the Great defeated the Swedish king Charles XII. Oil on canvas, 90 x 112cm.

A steel engraving, colored by W. Steelink after Johannes Bosboom, depicts Peter the Great as a carpenter.





An engraving of Peter the Great supervising the building of St. Petersburg

multi-day-long revels whose symbols mocked the Church and which he led until the end of his reign.

In 1693, Peter's love of ships drew him to the open sea. In those days, all of Russia had only one seaport, Archangel, near the White Sea. Archangel is 130 miles south of the Arctic Circle and frozen six months of the year. From there, Russia conducted its meager sea trade. But it was still the sea. And at the height of summer, Peter and his retinue started out on the 1,000-mile journey from Moscow to see the sea for the first time. He wrote his mother letters of what he saw there and signed them "Skipper Peter."

And so, Massie writes, "impelled by the will of this strange sea-dreamer, the huge landlocked nation stumbled toward the oceans."

Peter Rules

Peter's extended adolescence ended in 1695 when at age 23 he set his sights on the Black Sea, controlled by the Ottoman Empire. No longer playing war, he led an overland march to capture the Turkish fortress of Azov

in an attempt to end Russia's isolation from the sea. The attack ended in failure. But it convinced Peter that Russia needed a large, modern navy, and he set about building it. The next year he returned to Azov and with the aid of 30 Russian ships, captured the fortress.

Ivan died in 1696, leaving Peter as sole ruler of Russia. The country would be at war for all but a single year until the end of Peter's reign. For most of the time, the enemy would be Sweden.

In 1700, Peter looked north to gain a foothold on the Baltic. To do that, he would need to defeat the Swedes, who were the preeminent northern power. Peter launched what became known as the Great Northern War. Begun with the disastrous Battle of Narva, it came to an end 21 years later when a treaty gave Russia lands on the Baltic that had previously been ruled by Sweden—including present-day Estonia. Russia agreed to pay Sweden 2 million Riksdaler and returned to the Swedes most of Finland, which Russia had captured.

"Russian victory over Sweden meant Russia was firmly established on the

Baltic, had its window on Europe and replaced Sweden as the dominant power in Northern Europe," Nicholas V. Riasanovsky writes in *A History of Russia*.

In the process, Peter reformed Russia's army. He took a force that disbanded every winter and he built a standing army, a professional fighting force manned by soldiers who served for life and were cared for by the state. By the end of Peter's reign, the army had 200,000 men, a number slightly smaller than that of the continent's powerhouse, France. The burgeoning army expanded the population of Russians who lived in service to the state.

Peter's gains in the war allowed him to turn his back on Moscow and build a glittering European capital on the Baltic. He established St. Petersburg in 1703.

He discovered his love for European culture and technology early, on his Grand Tour of Europe in 1697. Disguised (largely unsuccessfully) as Peter Mikhail, the tsar accompanied a Russian delegation to win assistance from the kings of Europe for Peter's war against the Turks. In this, Peter was unsuccessful, but particularly in the



Peter the Great on his deathbed, in a 1725 painting by Ivan Nikitin.

Netherlands and England, he was able to soak up the social and scientific advances of Protestant Europe, as well as technological skills like shipbuilding.

He brought to Russia Western innovations like coffee houses and newspapers, Western dress and education. And he infamously required his noblemen to shave their beards, levying a tax on those who refused.

Like Peter's other reforms, the tsar's beard edict was met with fierce suspicion. "Traditionalists objected on the ground that shaving impaired the image of God in men and made the Russians look like such objectionable beings as Lutherans, Poles, Kalmyks, Tartars, cats, dogs and monkeys," Riasanovsky writes.

Throughout Peter's reign, there were many who believed that he was, at best, a foreigner installed in place of the real

tsar or, at worst, the anti-Christ. Known for his ruthlessness (his own son, whom he suspected of treason, died after being severely tortured, and Peter had at least two of his mistresses tried on false charges of adultery), he nonetheless left an indelible legacy.

Peter died in February 1725, at the age of 52, from kidney failure. During the course of his 42-year reign, the giant of a man had transformed Russia from an isolated medieval nation to a major European power. The cultural revolution that Peter oversaw replaced antiquated social and political systems with ones that were modern, scientific and westernized. Today, many existing institutions of Russian government trace their origins back to his momentous reign. ●

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If the human eye were a digital camera, it would have 576 megapixels.

The longest Monopoly game in history lasted for 70 straight days.

The expiration date on bottled water is for the bottle, not the water.

Night vision goggles are green because the human eye can differentiate more shades of green than any color.

Your brain is more active when it's sleeping than when you are watching television.

The volcanic rock known as pumice is the only rock that can float in water.

The San Francisco cable cars are the only mobile National Monument in the world.

A firefly is actually a beetle, not a fly.

The White House was originally called the President's Palace. It was renamed the White House by President Theodore Roosevelt in 1901.

Earth is the only planet not named after a Roman god or goddess. **It costs** about three cents to make both a U.S. \$1 bill and a penny.

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ON THE LIGHTER SIDE

An elderly couple is having problems remembering things, so they go to the doctor to get checked out. They describe for the doctor the problems they are having with their memory. After checking the couple out, the doctor tells them they are physically okay, but that they might want to start writing things down to help them remember. The couple thanks the doctor and leaves. Later that night while watching TV, the old man gets up from his chair. His wife asks, "Where are you going?"

He replies, "To the kitchen." She asks him for a bowl of ice cream and he replies, "Sure."

She then asks him, "Don't you think you should write it down so you can remember?"

He says, "No, I can remember that."

"Well," she says, "I also would like some strawberries on top. You had better write that down because I know you'll forget."

He says, "I can remember that; you want a bowl of ice cream with strawberries."

"Well," she replies, "I also would like whipped cream on top. I know you will forget that, so you better write it down."

With irritation in his voice, he says, "I don't need to write that down, I can remember that."

He fumes off into the kitchen. When he returns 20 minutes later he hands her a plate of bacon and eggs. She stares at the plate for a moment and says, "You forgot my toast."

(excerpted from *Pretty Good Joke Book*)

Dates in History

1863: On July 4, the Confederacy is torn in two when General John C. Pemberton surrenders to Union General Ulysses S. Grant at Vicksburg, Mississippi. The Vicksburg campaign was one of the Union's most successful of the war.

1877: On July 9, the All England Croquet and Lawn Tennis Club begins its first lawn tennis tournament at Wimbledon, then an outer-suburb of London. Twenty-one amateurs showed up to compete in the Gentlemen's Singles tournament—the only event at the first Wimbledon. The winner was to take home a 25-guinea trophy.

1908: On July 26, the Federal Bureau of Investigation (FBI) is born when U.S. Attorney General Charles Bonaparte orders a group of newly hired federal investigators to report to Chief Examiner Stanley W. Finch of the Department of Justice. One year later, the Office of the Chief Examiner was renamed the Bureau of Investigation, and in 1935 it became the Federal Bureau of Investigation.

1943: On July 25, Benito Mussolini, fascist dictator of Italy, is voted out of power by his own Grand Council and arrested upon leaving a meeting with King Vittorio Emanuele, who tells Il Duce that the war is lost.

1969: On July 20, President Richard Nixon, along with millions of others, watches as two American astronauts walk on the moon. Later that evening, Nixon recorded succinctly in his diary that "the President held an interplanetary conversation with *Apollo 11* astronauts Neil Armstrong and Edwin Aldrin on the Moon."

www.history.com



WARMING UP TO **GREENLAND**

FROM DOG SLEDDING TO GLACIER GAZING, THIS RUGGED ARCTIC NATION IS RICH
IN ADVENTURES FOR EVERY AGE AND TASTE

BY ANDREW MYERS



Mads Pihl - greenland.com

Those who've ever caught a glimpse of the Northern Lights, even for the briefest moment, will never forget their fiery charm.

In Greenland, the Northern Lights are visible on every clear night three seasons a year—autumn, winter and spring. In summer, they would be there, too, but for the round-the-clock midnight sun outshining them. On most nights, they appear a ghostly emerald green, but they can also venture into fiery reds or even purples on the very best nights.

“The Northern Lights are, without question, spectacular in Greenland,” says Sarah Woodall, an American who works as a tourism consultant for Visit Greenland, the national tourist board (www.greenland.com).

Though Greenland likely doesn't leap to mind as a tourist mecca, this rugged land three times the size of Texas that stretches almost to the top of the world is emerging as a surprisingly popular destination, and not just for the Northern Lights. Greenland is rich in adventures for every age and every taste. Some 60,000 visitors each year travel to this stunning Arctic land. While that number may not at first impress, consider that Greenland has only 56,000 permanent residents and the figure takes on added significance.



Northern Lights, Destination Arctic Circle

Mads Pihi - greenland.com

The Northern Lights are, of course, one of Greenland's star attractions, but they are just one of what are known as “The Big Arctic Five,” which include adventurous dog sledding tours, spectacular displays of ice and snow, incomparable whale watching and, of course, an engaging culture with roots stretching back thousands of years. Today Greenland offers a unique blend of Inuit and global influences—and is like no other place on Earth.

Greenland's centuries-old dog sledding tradition remains vibrant and

offers a distinctive vantage on the country's rugged beauty. Tour leaders, known as mushers, provide entrée into the history of dog sledding and the unique collaboration between man and animal that is sled dog life.

“Dog sledding experiences range from light day trips to more extreme adventures,” Woodall says. “You can take a few hours' tour around the backcountry just outside town, or you can take a longer excursion that includes overnight stays in small lodges.”



The “The Big Arctic Five” icons located on the opposite page are directly associated with Greenland's national brand, “Pioneering Nation,” a campaign based on Greenland's five core attractions. They are specifically meant to promote Greenland. Visit greenland.com.



Mads Pihl - greenland.com



Coffee break on the dog sled trail

Lodges are simple but cozy, and all provisions are carried aboard the dog sleds, as the Inuit hunters have done for ages. The prime season for dog sledding is March and April, when the winter snows linger but the sun has emerged from its months-long slumber beneath the horizon. For the quintessential Greenlandic experience, try wearing traditional Inuit gear made of animal fur. Whether you choose modern or traditional gear, however, trail outfitters will have it all.

Third of The Big Arctic Five is Greenland's magnificent ice and snow. Contrary to its verdant name, 80 percent of Greenland is covered in a perpetual sheet of ice that towers two miles thick in places.

Chief among the ice highlights is the Greenland ice sheet, easily accessed from the town of Kangerlussuaq in the Arctic Circle region, where a lone unpaved back road leads almost directly to the ice sheet's edge (a two-hour drive by all-terrain vehicle).

The Greenland ice sheet is in constant motion, albeit at a glacial pace. The lucky visitor will bear witness to massive chunks of ice breaking free with a thunder as they crash to the land or water below, a process known affectionately as calving. Once the icebergs hit the water, it is possible to hear them "breathe" as they pop and release oxygen while floating alongside one another.

The best-known spot for iceberg gazing is the Ilulissat Icefjord on Greenland's western coast, which is

HOW'S THE WEATHER?

Greenland has an arctic climate with average temperatures that do not exceed 10° C (50° F) in the warmest summer months. However, in the southern part of the country and the innermost parts of the long fjords, temperatures can rise to more than 20° C (68° F) in June, July or August. The cold season in Greenland lasts from December to April, with average daily temperatures falling below -3° C (26° F).



"Greenland Map" ©iStockphoto.com/wowchikyury

Mads Pihl - greenland.com



Norbert Eisele-Hein imageBROKER/Newscom



Top, cooking musk oxen; bottom, rich bits of mattak, humpback whale meat, an Inuit specialty

A TRUE TASTE OF THE ARCTIC

Greenland boasts a distinctive cuisine that is focused on sustenance from the land and the sea, but increasingly includes fresh elements raised during the short-but-sweet growing season in South Greenland, affectionately known as the “Garden of Greenland.” The traditional foods of Greenland are largely dependent on the game that roams the rocky coasts, namely reindeer and musk ox.

“Most of our Greenlandic specialties here are wild-caught. They are absolutely sustainable and organic in the truest sense of the word. Nothing is mass-produced,” says tourism consultant Sarah Woodall. Reindeer meat with crowberry sauce is a local favorite. On the domesticated side, the South Greenland lamb is absolutely delicious, she says.

From the sea, whose cold waters produce fish of exceptional quality, the salmon is a highlight and, surprisingly, not available anywhere else in the world. “We don’t export our salmon, so to taste such a unique flavor one must come to Greenland,” Woodall says. The halibut, shrimp, trout and mussels are exceptional, as well. In the spring, the Greenlandic tradition calls for lumpfish roe. “With some crème fraîche and chopped red onion on a blini, it’s delicious,” says Woodall.

For those who want to experience exotic Greenland dining, traditional whale and seal meats are still eaten and are available in fish markets and restaurants. Mattak is a small but rich bite of whale skin with blubber. Suaasat is the national soup, a flavorful broth with boiled seal meat.

“Whale and seal meats are delicacies here. They are very lean and maybe one of the most nutrient rich foods available,” Woodall says, “For the gastronomically adventurous, they represent a true taste of the Arctic.”

Musk oxen with crowberries

Mads Pihl - greenland.com





GETTING TO— AND AROUND— GREENLAND

Remote as Greenland seems, it is accessible year-round. Using Iceland as a stepping-stone, North Americans can easily reach Greenland's hot spots via flights with Air Greenland and Air Iceland. Should you find yourself in Europe, it is also possible to reach Greenland from Copenhagen, Denmark. The spring travel season starts in March, with the popular summer season beginning in June and lasting through fall.

Cruises along the scenic coast are available from the late spring to early fall. Nearly half of Greenland's 60,000 tourists each year come by cruise ship, tracing the coast and disembarking for a few hours here and there in select towns along the way.

As for accommodations, Greenland boasts two four-star hotels, but there are plenty of options, including small hotels, bed-and-breakfasts and even home stays with a local host family.

Getting from city to city is not so easy as hopping in the car and heading out. There are no roads between towns, so tourists and residents alike must take either a flight or the coastal ferry to get from place to place.



ICE & SNOW

Mads Pihl - greenland.com

The Iluliattoq lake at the ice edge near Kangerlussuaq

filled with freshly minted icebergs. "Photos simply cannot do justice to its beauty, scale and significance," Woodall says.

A few hours north by boat from Ilulissat is a glacier known as Eqip Sermia. Visitors can stay in the Glacier Lodge Eqi, an eco-lodge with an on-site chef, which is located just across from the glacier. Boat tours to other Greenlandic glaciers are also available from the towns of Nuuk, Narsarsuaq and Tasiilaq. For a truly spectacular introduction to the ice, however, Woodall recommends a "flightseeing" tour by small plane or helicopter.

In summer months, Greenland is renowned for whale watching. Many are drawn to the fish-rich waters near Nuuk, the capital city, to see the pod

of humpback whales that returns year after year to feed there.

The whales are fascinating creatures to observe, Woodall says, whether seen at a distance or within meters. When the mighty animals surface to breathe, they release a show-stopping mist, as their blowholes pop open with a powerful whoosh.

Last but not least of The Big Arctic Five, of course, are the people of Greenland. Greenland, where Danish and Kalaallisut are the primary languages, prides itself on being a nation of pioneers. From the Inuit who ventured here across North America some 5,000 years ago and shaped a life in this challenging environment; to Erik the Red and his Viking cohort who landed in South Greenland in the

Summer in Tasiilaq. Right: a whale diving off the Greenland coast



Mads Pihl - greenland.com



WHALES

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TherIn-Weise/picture alliance/Arco Images/News.com



PIONEERING PEOPLE

An icefjord cruise near Ilulissat. Right: A group of people in traditional clothes, Holsteinborg

10th century; to the Danes who claim it as a self-governing territory today, Greenland has always embraced a pioneering spirit of self-reliance and adventure.

As ever, the operative word for Greenlanders is adaptation. It is in

the people's remarkable ability to adapt to the land, to the sea, to the changing climate and, most of all, to the global culture that makes this place such a compelling destination. That spirit is alive and well and extends to all who visit.

“With all this open space, physical beauty and engaging people, Greenland is meant for adventure,” Woodall says. “Some people just book a flight and walk out into the nature. Greenland is freedom.”

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BUILDING Hoover Dam

An engineering wonder, it was an American triumph over the Great Depression

BY EUGENE FINERMAN

"TEN YEARS AGO the place where we are gathered was an unpeopled, forbidding desert. In the bottom of a gloomy canyon, whose precipitous walls rose to a height of 1,000 feet, flowed a turbulent, dangerous river."

So began President Franklin D. Roosevelt, speaking in Nevada to a crowd of 10,000 and a radio audience of millions. What had once been a desolate chasm now was the site of "the greatest dam in the world," and the president had come there to celebrate its completion. Today we know Hoover Dam as a national landmark, but in 1935 it was an engineering wonder. Beyond the heroic feat of harnessing the Colorado River, the dam had a psychological importance to the American people. It seemed a triumph over the Depression.

The construction of Hoover Dam is remembered as a hallmark of the

New Deal. Yet the dam was rightfully named for Herbert Hoover. Now remembered as the hapless president in charge during the collapse of the American economy, Hoover had enjoyed the highest regard as secretary of commerce (1921–28). In that capacity, he was the advocate and arbiter of the plan to build a dam on the Colorado River. Hoover brought a unique insight to the project. Before his life in public service, he had made his name and fortune as an engineer. He fully understood all the project's challenges—and he was engrossed by them.

River seems too placid a term for the Colorado, a 1,400-mile torrent. Its wild power carved out the Grand Canyon, but such raw energy also defied man's attempts to utilize the river. In the early 20th century, Southern California had built channels on the river to irrigate the Imperial



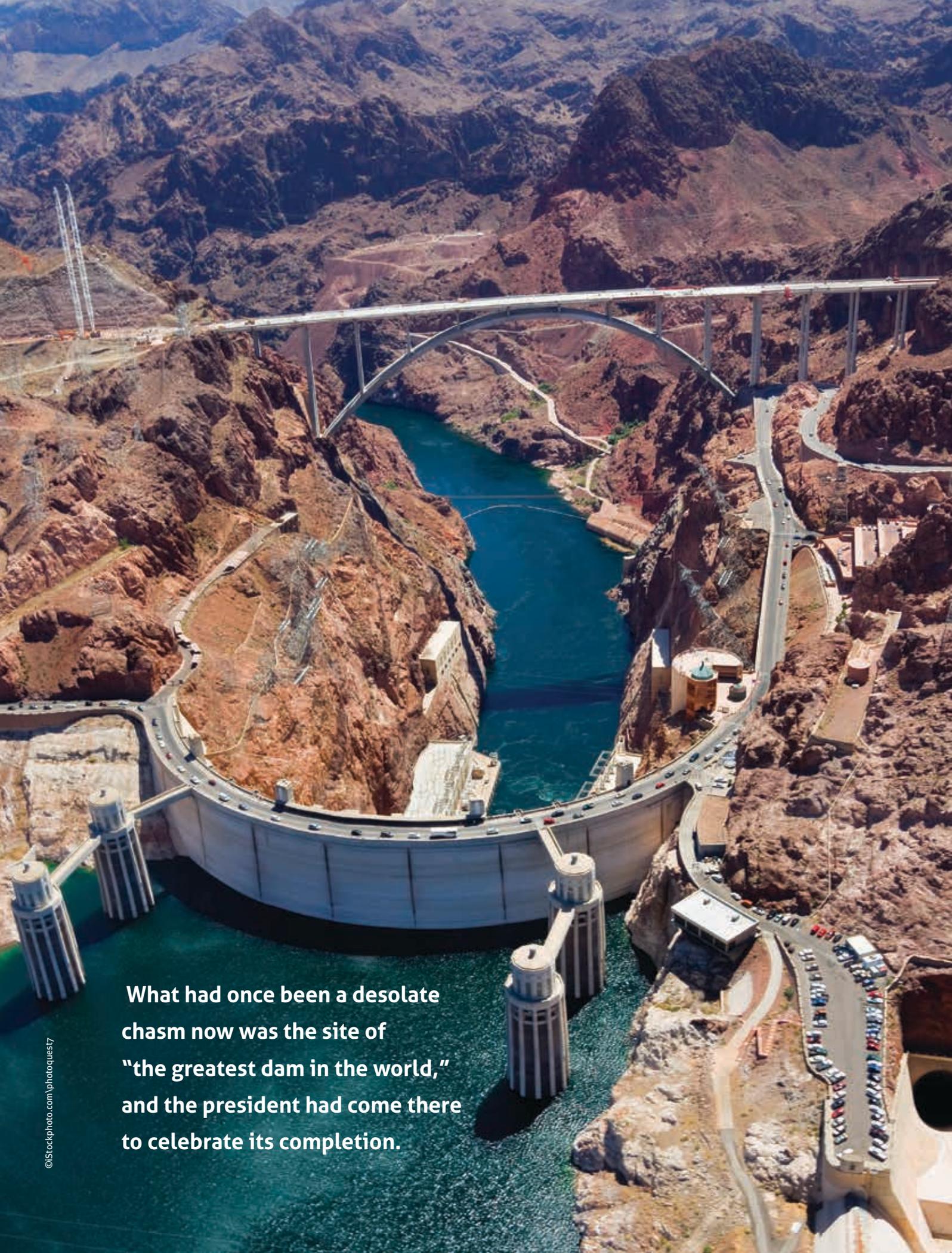
H.W. Goodall at Hoover Dam during the construction

Valley. During one of its periodic floods, the Colorado raged through those channels, inundating the valley and creating California's largest lake: the 350-square-mile Salton Sea. That disaster proved the futility of half measures and wishful thinking. If the river was ever to be controlled, it required the construction of a dam.

But where would that dam be located? The Colorado flowed through seven states: Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming. All had to agree to a federal project on their land and the subsequent allocation of the river's waters. In 1922, Secretary Herbert Hoover helped forge that agreement: the Colorado River Compact. Then began the groundwork—literally: Government surveyors spent four years along the river's route looking for the most promising site for a dam. Geology was

Black Canyon showing conditions at the dam site prior to beginning of excavation between the cofferdams, 1933.





What had once been a desolate chasm now was the site of "the greatest dam in the world," and the president had come there to celebrate its completion.



Before the dam could be built the Colorado River had to be diverted through tunnels. This piece of equipment, named a “jumbo rig,” was designed to speed up the tunnel drilling process. Built on the back of a 10-ton truck, 24 to 30 drills could be operated at once. Right: Drillers excavating the dam foundation on the Nevada side of Boulder Dam, 1933.

not the only consideration. California, with its burgeoning population, had the loudest demand for the water and the electricity that would be generated by the dam. The sale of that electricity would recoup the dam’s cost. So politics and geology had to find a juncture: It was the Black Canyon, along the Arizona and Nevada borders.

Such a project would be under the U.S. Bureau of Reclamations. Its surveyors and engineers undertook a feasibility study of the site. Their report was favorable but contained significant and daunting concerns. The chosen site was a desolate canyon, 30 miles from any roads. Factories would have to be built in the middle of the desert. The dam itself would be the world’s largest and a masterpiece of engineering; taming the Colorado required nothing less. With the exception of wars, the construction of the dam would be the most expensive undertaking by the federal government to date. Yet, the dam was possible; it certainly would benefit the Southwest, and the costs eventually would be recouped. In 1928, with a booming economy and limitless optimism, Congress and President Coolidge could afford the world’s most expensive dam. The construction of Boulder Dam was approved.

The work at Black Canyon would not begin until 1931, but the unemployed began streaming into nearby Las Vegas a year early.

When Herbert Hoover was elected president that same year, the unemployment rate was 4 percent. When he was voted out of office four years later, the rate was 23 percent. The brilliant engineer proved a tone-deaf politician. He consistently underestimated the growing Depression, claiming “prosperity is just around the corner.” However oblivious he was to the Depression, Hoover remained committed to Boulder Dam. It would provide employment, stimulate the economy and foster future growth.

The work at Black Canyon would not begin until 1931, but the unemployed began streaming into nearby Las Vegas a year early. The aspiring laborers camped out in public parks. Some were able to find immediate work: the laying of rail lines from Las Vegas to the canyon.

In January 1931, the Bureau of Reclamations opened bidding for the construction of the dam. Described in a 100-page book, the project would require building a 700-foot-high dam; at the time, the world’s highest dam was only 420 feet. In addition, two power plants were to be built. All this was to be completed in seven years. The government would provide the construction material. As a guarantee of performance, a \$5 million bond would be required of the construction firm. In the economy of 1931, no single construction company could afford that bond. However, a group of firms formed a joint venture to bid on the project. They named themselves Six Companies and calculated their lowest possible offer. It was \$48,890,995 (about \$748 million today)—and the winning bid.

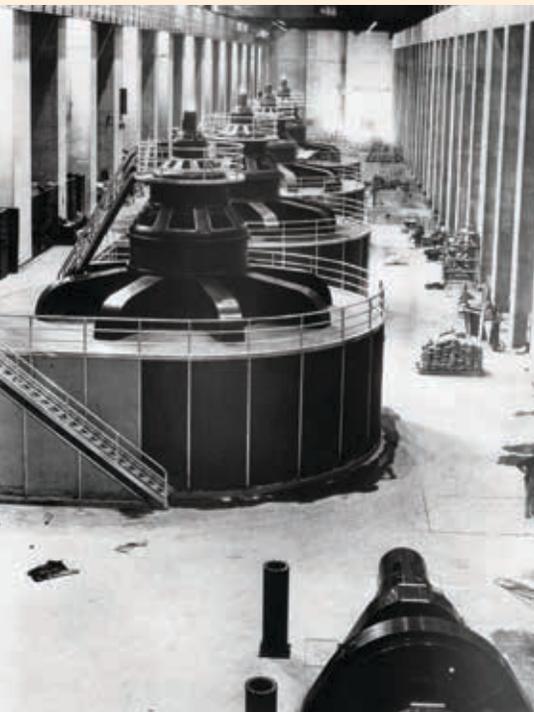
In the spring of 1931, Six Companies could hire 3,000; four times that many people applied. The average wage was \$.65 an hour (\$11 an hour



Setting the foundation

today). Men worked eight-hour shifts, every day of the week. The first phase of the project was the diversion of the Colorado River. Its waters would be diverted around the dam construction and flow out farther downstream. To channel that water, four tunnels were dug and blasted through solid rock. Each tunnel was 56 feet in diameter and

Generators at Hoover Dam power house, 1937



Everett Collection/News.com

three-quarters of a mile in length. Fifteen million cubic yards of debris were removed. That debris would be used in an earthen dam to block the river and divert its waters into the tunnels. By November 1932, the tunnels had been completed—11 months ahead of schedule.

With the river diverted, construction now began on the dam. The work started with the excavation of the riverbed, digging down through 40 feet of mud and silt to bedrock. A half million cubic yards of river bottom was dredged. The dam now had its foundation of solid rock. At the same time, the walls of the canyon were being blasted smooth by jackhammers and dynamite—work done by men suspended by ropes, harnesses and tenuous luck. Above the canyon the company had constructed a factory for making concrete. Through a series of aerial cables, a 20-ton bucket of concrete could be transported anywhere within the construction site. As the construction got underway, the buckets arrived every 78 seconds.

The work was nonstop: three eight-hour shifts a day, every day of the week, and the workforce was now 5,000. Those workers lived on the site in a community called Boulder City. The government subsidized housing and

food. Neither Six Companies nor the government had anticipated that men would bring their families, too. So schools had to be improvised.

Millions of tons of concrete were being poured into trapezoidal blocks, which held steel pipes inside, through which cool water flowed to speed the concrete curing process. (Once the concrete block had stopped contracting, the pipes were filled with grout.) In turn, the blocks formed interlocking columns, and the dam began to take shape. It was convex; the curving arch would face the water. At the same time, two power plants were being built. One was on the Nevada side, the other in Arizona. Water from the river would power its turbines, which then would produce 2 billion watts of electricity. That would serve the needs of 1 million people.

On February 6, 1935, the last bucket of concrete was molded into the dam. The construction was not quite finished; some grouting was needed, and there were cosmetic touches as well. But its majestic structure was evident. Boulder Dam was 726 feet high, 1,244 feet wide and 660 feet thick at the base, tapering to a thickness of 45 feet at the top. It surpassed the masonry of the Great Pyramid of Egypt, the first man-made structure to do so. The diversionary tunnels were plugged, and the Colorado River began to fill behind the dam and form a lake—a process that would take two years. That lake, which would store 9.2 trillion gallons of water, would be named for the director of the Bureau of Reclamations: Edward Mead.

Boulder Dam was dedicated on September 30, 1935. The American public saw it as a triumph, a testament to the American spirit even in those dark times. The dam seemed like a reassuring promise. Its look was modern, clean and streamlined, ready for the future. In 1947, the dam was renamed for Herbert Hoover. He had described the dam as “the greatest engineering work of its character ever attempted by the hand of man”—and he was alive to enjoy some credit for that achievement. ◀

THE DIXON BRAND PROMISE /

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Hose fittings, valves backed by 100 years of innovation, quality

Reprinted with permission from BIC Magazine, April 2015.

> *“Because we are a manufacturer and have control of the processes and product, we have a high level of confidence all of our products are of the best quality they can be.”*

— *Bob Grace, president, Dixon*

Not many companies have 100 years of history, but Dixon, a leading manufacturer and supplier of hose fittings, valves and accessories, will celebrate that milestone in 2016. And the company has served the oil and gas

industry as one of its primary markets for almost as long.

“Our value proposition has always been to be the easiest company to do business with,” explained Grace.

“We are a domestic manufacturer with a very broad product mix, and support that with a lot of field training. Our training ensures the safe and proper use of our products, and we are willing to do that at our expense to ensure customers are using products in the proper manner.”

To that end, Dixon opened an innovation and training center three years ago at its headquarters in Chestertown, Maryland. Through its alliance with distributors, the company hosts not only the distributors and their salespeople but also actual end users on-site.

“We look at how our products can be improved to make the lives of end users easier,” said Grace. “Our innovation center is staffed with engineers whose jobs are to ensure we



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In 2012, Dixon acquired Eagle America which specializes in the design, manufacturing and testing of bellows seal gate and globe valves. Bellows seal valves help eliminate fugitive emissions of toxic or regulated fluids, and prevent corrosive or harmful atmospheric conditions from entering the process. They also minimize maintenance and reduce life cycle costs in process plants including steam, cryogenics, heat transfer oil and vacuum systems. Bellows seals are considered zero-emission devices as defined by the EPA.

Dixon also manufactures API couplers, swivels and dry disconnects. The company has introduced a

"Crude-by-Rail Campaign," which is a line of products to facilitate safe and efficient unloading of crude into refineries.

"That was a need that came from the field, and we designed product around it to meet those needs," explained Grace.

"We look at how our products can be improved to make the lives of end users easier." – Bob Grace, president, Dixon

As with these and other products, Dixon's high quality has remained consistent. Dixon products undergo rigorous testing including regular inspections, hydrostatic testing, and lab or field tests, all examples of Dixon's commitment to quality control.

Along with product expansion, the company is adding 70,000 square feet to its quick coupling building in Dallas, North Carolina.

"We are looking to the future," said Grace. "We continue to invest in automated machinery to keep up with growing demand from our

customers. And, we're exploring new valves and dry disconnects used in alternative transportation fuels like LNG." ➤

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Pedal Pushers

Cycling offers a fun and effective low-impact workout

> The older we grow, the more we need to exercise. Yet the viable options for physical exertion dwindle as we age. Cycling stands among just a handful of activities that can truly be considered lifetime sports.

“Even if you haven’t ridden for 30 years, you can still pick it up quickly and get a good, low-impact workout,” says Kristine Karlson, MD, an assistant professor of family medicine at the Dartmouth-Hitchcock Medical Center in Lebanon, New Hampshire. Karlson is the author of “Getting Started With Cycling” for the American College of Sports Medicine (ACSM).

Physical health experts have long championed cycling. Judging by the legions of Lycra-clad weekend warriors on the roads, and the many cars laden with bikes heading for trails unknown, Americans across the age spectrum are taking note.

In 2008, the National Sporting Goods Association pegged the number of American riders at 54.9 million and rising, noting that cyclists outnumbered

golfers, tennis players and skiers combined. No matter how you slice it, millions of people are mounting up and pushing the pedals toward better health.

It is hard to argue against the benefits. Cycling burns calories, increases muscle strength and tone, and improves endurance and cardiovascular health—all by way of a low-impact sport that is easy on the joints.

“Cycling is one of those activities the joints love, so if you have knee, hip or ankle problems, it could be your solution,” Karlson says.

The benefits of even a moderate level of cycling can be tremendous. According to the ACSM, breaking a sweat just 30 minutes five times a week is plenty to see a fitness reward. Just start out short and easy, and keep expectations in check.

“It may be hard at first, but eventually you get to where you don’t

feel right if you haven’t exercised,” Karlson encourages.

If you think cycling may be for you, avoid getting mired in the dizzying array of gear that is available these days—the uniforms, saddlebags, clip-on shoes and so forth. Focus first on the basics: Choose the right style of bike and the right fit for you.

“If you are just beginning, you belong in a bike shop. Don’t just pick the blue one. You want to take your time; test ride. Get properly fitted for a bike,” Karlson says.

For beginners, the best choice is probably an upright style that combines facets of racing and mountain bikes, a style that is less physically demanding on the back and neck. While not as speedy as a road bike, or as rugged or agile as a mountain bike, it is a versatile choice that will accommodate the widest array of riding needs.

Above all, Karlson insists on the right seat, known in cycling as a saddle. With upright-style bikes, the rider’s weight gets concentrated on the hips and the right saddle becomes paramount. There are saddles designed specifically for men and for women to accommodate different bone structures; wider for women, narrower for men.



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“If you are just beginning, you belong in a bike shop. You want to take your time; test ride. Get properly fitted,” Karlson says.



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“The right saddle can make all the difference in the world. It’s not all about cushiness. Some people buy gel pads only to slide all over the place and end up with blisters,” Karlson explains.

If the bike you like doesn’t have a good seat, be ready to pony up a few extra bucks for a better one. They are easy to replace and most bike shops will offer a discount on the upgrade if you buy a bike as well.

With proper bike and saddle, there are a few other items of gear that even the beginner should not be without. First up is a helmet; only the most foolhardy riders go without one these days. Hydration is important, too, so a water bottle and frame-mounted holder are a good idea, but there are wearable types that also work just fine.

You can forgo the biking shoes that clip into the pedals, but a set of metal toe cages will allow you to push and pull as you ride to get the most power out of every stroke. A repair kit with basic tools, replacement inner tube and a pump is also a must-have.

Last but not least, grab a few items that aren’t for the bike at all. Bring sunblock and thoroughly review the latest safety tips. The League of American Bicyclists’ Ride Smart program is a great resource at: www.bikeleague.org/ridesmart.

“Then,” Karlson says, “just get out there and ride!”



FEEL THE BURN

Cycling is a great way to burn calories, with the amount depending on how vigorously you work out. A person who weighs about 160 pounds will burn about:

- **288 calories** an hour cycling at a leisurely pace
- **614 calories** an hour while mountain biking on off-road trails and hills
- **509 to 826 calories** an hour on a stationary bike, depending on the setting.

SOURCE: LIVESTRONG.COM

“Bike chain” ©iStockphoto.com/vajt

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Good and Numb

How anesthesia transformed modern medicine

> “Gentlemen, this is no humbug!” declared surgeon John Collins Warren, as he turned away from an operating table to address an amphitheater of awestruck medical students at Massachusetts General Hospital on Oct. 16, 1846.

Warren was serving as supervising surgeon during a watershed moment in the annals of medicine. A young dentist named William T.G. Morton had just successfully administered anesthesia to a surgical patient, Edward Gilbert Abbott, who required the removal of a tumor from his neck. After breathing in the ether vapor, Abbott “sank into a state of insensibility,” Warren noted later.

Morton branded his sulfuric ether concoction “Letheon” after the underworld river of Lethe. According to Greek mythology, drinking from the river ameliorates disturbing memories.

Prior to the momentous Abbott operation, surgeons had little other than opium and alcohol to offer patients who had to endure the excruciating pain of surgery. That all changed with the advent of “anesthesia,” a term that would later be coined by Oliver Wendell Holmes Sr., from the Greek, meaning “without sensation.”

Holmes exulted in the invention: “The fierce extremity of suffering has been steeped in the waters of forgetfulness, and the deepest furrow in the knotted brow of agony has been smoothed for ever.”

Of course, the dream of inducing unconsciousness and muscle relaxation during medical procedures dates long before that autumn day in Boston.

Crude anesthetics to dull the senses and induce sleep have been around since ancient times. Throughout

Europe, Asia and the Americas, species of *Solanum* plants containing tropane alkaloids were used for anesthesia. Incan shamans and members of other Native American societies had patients chew on coca leaves while operations were performed.

In 1525, ether was first used on animals by Swiss physician Paracelsus. Some 15 years later, German botanist Valerius Cordus synthesized diethyl ether by distilling ethanol and sulfuric acid, noting its medicinal properties.

More than two centuries later, an English chemist named Joseph Priestley isolated the gas nitrous oxide. (It would not be used in surgeries, however, until decades later, in the 1860s.)

Interestingly, four years before the 1846 Letheon breakthrough, an American surgeon/pharmacist named Crawford W. Long operated on a patient

under the influence of ether. However, Long failed to announce his discovery until 1849, thereby leaving Morton with credit for the first public demonstration of ether anesthesia.

Meanwhile, the use of chloroform in anesthesia spread during this period. Most notably, it was given to Queen



Daguerreotype believed to be a re-enactment of the first demonstration of ether anesthesia by Dr. William T.G. Morton at Massachusetts General Hospital on October 16, 1846

Everett Collection/Newscom

Victoria in 1853 during the birth of her eighth child, Prince Leopold. The queen would later write in her journal that “the effect was soothing, quieting and delightful beyond measure.”

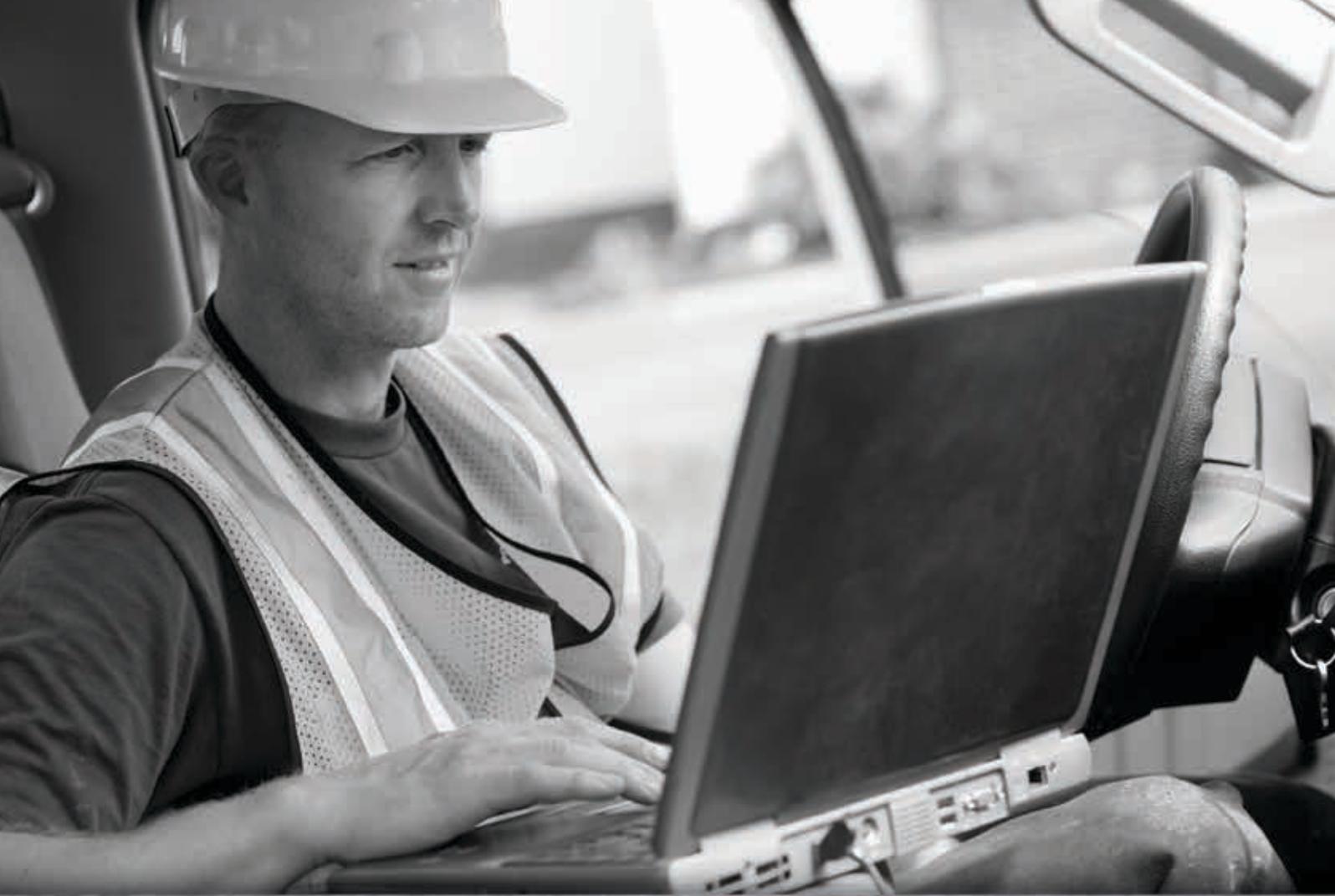
Today, only nitrous oxide is still used among the original famed anesthetics. Chloroform and ether have been replaced by safer general anesthetics.

The field of general and regional anesthesia and sedation continues to

Prior to the momentous Abbott operation, surgeons had little other than opium and alcohol to offer patients who had to endure the excruciating pain of surgery.

evolve, allowing medical personnel to conduct important, lifesaving procedures throughout the world.

Dr. Warren was absolutely right: This is no humbug! ■



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