Chapter 1

The Saudi Arabia of Coal

IF YOU WANT TO FEEL the spirit and exuberance of a place that's rich in fossil fuels, you don't have to travel to Dubai. Just visit Gillette, Wyoming, the self-proclaimed Energy Capital of the World. Out here on the vast, open prairie, where the great Sioux warrior Crazy Horse once roamed and not far from where Lieutenant Colonel George Armstrong Custer made his last stand, you don't find many people worrying about the fact that the world may be running out of fossil fuels. Gillette is in the heart of the Powder River basin, a 250-mile-long wind-sculpted hollow between the Bighorn Mountains and Devils Tower National Monument which contains some of the richest reserves of oil, gas, and especially coal that remain in America.

Not surprisingly, living in close proximity to this buried treasure makes everyone into an energy optimist. At a coffee shop in town, I met a woman who told me that when she runs on the treadmill in her living room, she likes to turn all the lights on in the house, as well as the stereo, the TV, and every electronic appliance. "I like to feel the energy," she told me. "It keeps me going." At Energy Dodge, one of several national park–size car dealerships in Gillette, you'll find row after row of 4x4s with big, thirsty Magnum V-8 engines. "You mean 'high-birds'?" a salesman joked when I stopped in to ask if any customers were asking for more fuel-efficient vehicles. "We shoot them out here."

Beneath all the excitement, however, lurks a question: exactly how much oil, gas, and coal is left out there beneath the prairie? The question is especially relevant to coal, which is by far the most bountiful of the three fuels in the region. The best of the oil and gas reserves have already been pumped out in Wyoming, and although there's a lot of oil and gas left, much of it is in restricted areas or hard to get at. But coal! Everyone knows there's a lot of coal in the Powder River basin. All you have to do is drive a mile or so outside town to a viewing platform built on the side of the road. It's the same kind of viewing platform you see in other regions of the country for scenic vistas of spectacular mountains and valleys. In Gillette, the scenic vista is of sixty-foot-thick coal seams in an operating mine.

When you see these great black seams and then imagine them running beneath your feet and under the city of Gillette — and under the sagebrush all the way out to the Bighorn Mountains nearly fifty miles to the west, then another fifty miles to the north beyond the Montana border, and then seventy-five miles or so to the south, nearly down to where the wagon wheels of migrants on the Oregon Trail cut ruts in the rocks — it's easy to see why people who live in the Powder River basin feel so optimistic about coal's place in America's energy future. As Fenimore Chatterton, Wyoming's secretary of state, put it back in 1902, "Coal? Wyoming has enough to run the forges of Vulcan, weld every tie that binds, drive every wheel, change the north pole into a tropical region, or smelt all hell!" A more sober assessment, provided by the U.S. Department of Energy, suggests that Wyoming has about 42 billion tons of mineable coal left in the ground. At the current rate of consumption, that's enough to supply the entire United States for more than forty years.

But it's coming out quickly. Today about 40 percent of the coal burned in America — about 400 million tons — is mined in the Powder River basin. The vast majority of that coal comes from thirteen huge strip mines near Gillette. One of the biggest is Cordero Rojo, which is owned by Kennecott Energy, a subsidiary of Australian mining giant Rio Tinto, and which sprawls over 6,500 acres about fifteen miles south of town. Entering a big strip mine is like visiting the supersize world of the Brobdingnags: Each mining pit (there are five at Cordero) is big enough to bury a fleet of aircraft carriers. The haul trucks make ordinary pickup trucks look like Tonka toys. As you travel down into a pit, you descend through striations of yellow sandstone and gray mudstone, moving back in time 50 million years, until you confront a black wall. "Buried sunshine," the coal industry's PR wizards like to call it.

From the bottom of the pit at Cordero Rojo, however, the view of America as the land of eternal coal is not quite so clear. After all, it's one thing to have 42 billion tons of coal buried in the ground; it's quite another to get it out. I saw this for myself one afternoon when I accompanied a twenty-eight-year-old shift foreman named Travis Todd on his rounds at Cordero. Every day, Todd tours the five pits at Cordero, looking for signs of trouble. Most often, his eyes are on the highwall — the 240-foot-high cliff of mudstone and sandstone that rises above the coal seam. Thirty years ago, when corporations began mining in the basin, the coal was buried only twenty feet or so below the surface — you could practically dig it out with a spoon. But because of the way the coal seams slope downward across the basin, all the easy stuff is gone, and the coal is buried progressively deeper with each passing day. Now the pit walls at most of the big mines are sheer cliffs. How stable are they? How much deeper can the coal companies mine without triggering collapses? Given the downward slope of the coal seam, it's not hard to see that ten or twenty years in the future, mining coal in the Powder River basin will be an increasingly complex, expensive, and dangerous operation. And if this is happening in the thickest, richest coal seam in America, what's going on in places such as West Virginia and Pennsylvania, where all the easy-to-get coal was mined out by the 1950s?

As a precautionary measure, engineers at Cordero Rojo have cut back the highwalls in some pits with a series of catch benches, or steps. It looks a little like the terraced walls of Machu Picchu. The idea is to stop or slow a collapse before it reaches the bottom of the pit, perhaps burying the men and equipment working below. These dangers are not theoretical. In 2002, at Arch Coal's nearby Black Thunder mine, a section of highwall fell, crushing a bulldozer and killing the man operating it. A month earlier, at the same mine, a rock tumbled down off the highwall and hit a pickup truck passing below, leaving the driver paralyzed.

Part of Todd's job is to spot potential danger signs and get them fixed. On a trip into the north pit, we idled along in his truck at the bottom of the coal seam while Todd scanned the highwall, looking for any cracks or signs of instability. You could see sections where big chunks of mud and sandstone had fallen away. He pointed to a thin stream of water trickling out about two hundred feet up, a sign of possible collapse. "That's something we don't like to see," Todd said, making a note of it in his logbook.

"Do you realize we have 250 million years of coal?" President George W. Bush boasted in a speech touting energy independence in 2005. He meant, of course, 250 years' worth of coal. But it's easy to get worked up when you're talking about America's vast reserves. When Tennessee senator Lamar Alexander pushes for more funding for "clean coal," he justifies it by talking about America's "500-year supply." Similarly, when Wisconsin Energy, a large electric utility, was making its case for a new coal-fired power plant, the company argued that coal was superior to natural gas because America's gas supplies are declining, while there is enough coal to last "almost 500 years." But Peter Huber, a senior fellow at the Manhattan Institute whose views have been widely promoted by the Greening Earth Society, a pro-coal trade association, gets the prize for unbounded optimism. He has called the supply of coal in North America "essentially unlimited."

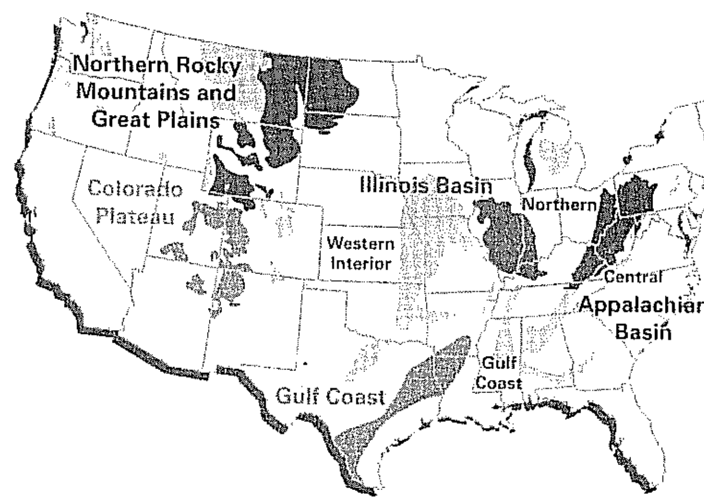
In a sense, Huber is right: Strictly speaking, there will be no shortage of coal in America in the foreseeable future, and the number of years our coal reserves will last depends on how eager we are to burn it and how much better we get at mining it. In this sense, the accuracy of the official estimate from the Energy Information Administration (EIA) — the statistical arm of the U.S. Department of Energy — that the United States has 250 years' worth of recoverable coal reserves is not important. What is important is understanding what it will take in economic, environmental, and human terms to get it out of the ground. And this is where the talk about America's 250-year supply runs into trouble.

When coal boosters like President Bush and Senator Alexander tout the virtues of America's reserves, they speak as if all that coal

was sitting in a big, shiny pile in the middle of Illinois or Tennessee just waiting to be shoveled into a coal plant. Unfortunately, that's not the case. A good percentage of the coal that's left is too dirty to be burned in conventional power plants, and much of it is buried in inconvenient places — under homes, schools, parks, highways, and historical landmarks. It can be mined, no doubt about it, but it won't be cheap, and it won't be pretty.

In part our unsophisticated view of coal reserves is a legacy of coal's decline. Americans stopped burning coal for heat and locomotives stopped burning it for power not because we were running out of it, but because it was displaced by cleaner, more efficient, and more convenient sources of heat and power. There was no point in studying coal reserves because the supply of coal was never an issue: it was quite obvious to everyone that there was plenty of cheap coal left in America. The problem was, would anyone want to burn it?

Now we do. And now it's worth asking some questions about that 270-billion-ton bounty of fossil fuel: Where exactly is all this coal? Is it anywhere near the power plants that burn it? Are there big differences in quality? How expensive will it be to get it out of the ground? How dangerous? What will America look like when we're finished mining it?



U.S. COAL FIELDS

These are not questions that coal boosters are eager to answer. In an era of declining resources, the great bounty of coal has always been one of the industry's best arguments for burning more. In this sense, America is more like "the Saudi Arabia of coal" than the coal industry cares to admit. Just as the last thing the Saudi oil ministers want is a true accounting of their remaining oil reserves, the last thing Big Coal wants is a close accounting of what it will take to get 270 billion tons of coal — or even 50 billion tons, for that matter — out of the ground.

"You hear the industry guys talking about it in private; they know it's not a good situation," Nick Fedorko, the head of the coal unit at the West Virginia Geological and Economic Survey, told me. "But they really don't want to talk openly about it. Mining requires a huge amount of capital investment, and if investors begin to believe that there is not as much easy-to-get coal in the ground as they have been told, then they might lose confidence. And if they lose confidence, the whole business might begin to slide downhill." Which is exactly why nobody in the industry is in any big rush to correct the myth of eternal coal in America. "People in the industry find comfort and security in these exaggerations," explains Marshall Miller, a respected geologist and coal industry consultant. "The coal industry is fighting so many battles on so many fronts — this is their one ace in the hole, and they are determined to keep it."

Coal is a creation of the earth's recent past, a legacy of the march of life from the sea onto the land. For most of the planet's 4.5-billion-year history, the earth was a hot, barren rock covered with exploding volcanoes and briny seas. Only about 400 million years ago did the first primitive life forms, multicelled algae, appear in the oceans. Fifty million years or so after that, those algae moved onto the land, evolving into mosses and, eventually, primitive plants and trees. It is the remains of this period, known to geologists as the Carboniferous Period, that created most of the fossil fuels we have today, including the great Appalachian coal bed that stretches from Pennsylvania to Alabama.

During the Carboniferous, the seas rose and fell in glacial cycles, flooding the swamps along what is now the Atlantic coast with seawater for millions of years during warm periods, then retreating

again as the climate cooled and ice formed. Odd trees evolved in these swamps. The two most common types were lepidodendron and sigillaria. *Lepidodendron* trees were up to 175 feet tall and 6 feet in diameter at the base, with a few short, wispy branches at the top. *Sigillaria* trees were short and stout, 6 feet in diameter but only about 18 feet tall — more like big, leafy stumps than trees. When these trees died, they created vast mats of organic matter that were periodically covered with seawater, which cut off the oxygen supply and prevented organic decay. The creation of these swamps was further aided by an evolutionary quirk: 350 million years ago, the creatures that normally help break down the complex carbon compound in tree bark — herbivores, termites, and certain bacteria — hadn't evolved yet. With a temporary immunity from organic decay, these great mats of plant matter just kept piling up.

The creation of coal is a function of heat, pressure, and time. Plant matter is first transformed into peat — a mix of bark, leaves, roots, spores, and seeds that looks like chewing tobacco. But peat that remains near the surface will never become coal — it needs to be buried and squeezed, which creates heat and forces off the oxygen, hydrogen, and nitrogen and concentrates the carbon. Coal is divided into four ranks: lignite, sub-bituminous, bituminous, and anthracite. *Lignite* is the closest to peat, and it looks a lot like black dirt — you can still see bark and woody fragments in it. Lignite is only about 60 percent carbon. When lignite is cooked and pressurized a little longer, it turns into *sub-bituminous* coal, which contains more carbon and fewer impurities. *Bituminous* coal is even further refined. It contains about 85 percent pure carbon and is hard, flinty, and black. The highest rank is *anthracite*, which is comparatively rare and remarkably beautiful — glassy and iridescent. It is almost pure carbon and burns with a clean blue flame. If anthracite is cooked and compacted still further, it becomes graphite (not diamonds, as legend has it).

This ranking system doesn't do justice to the complexity of coal. To a coal connoisseur, coal seams are as identifiable as grape vintages. The composition of coal can change because of sudden geologic events: the eruption of a volcano can add ash and mercury; a sudden flood can inject impurities into a section of coal that makes it completely different from the coal located one hundred yards away. A chunk of coal contains virtually every element in the periodic table, and the ratio of these elements — particularly sulfur and heavy metals — to carbon is important in determining not only how the coal burns in the boiler of a power plant but also how much pollution it gives off. A ton of bituminous coal from Illinois might easily have ten times as much sulfur as a ton from West Virginia. Burning sulfur creates sulfur dioxide, which fouls the air and poisons people's lungs, making coal with a high sulfur content far less desirable for most power plants. Even relatively benign components such as sodium are important in the marketability of coal. For instance, when sodium is burned, it becomes a snotlike goo that fouls boiler tubes and drives engineers nuts.

Most of the coal formed during the Carboniferous is bituminous. The only sizable tracts of anthracite are in northern Pennsylvania, which took the brunt of the impact when the North American and African continents collided several hundred million years ago. The impact folded the mountains up like an accordion and drastically compressed the coal beds that lay within. Although clean-burning anthracite was in much demand for heating homes and powering locomotives in the nineteenth century, it's not mined much anymore, in part because the geography of the region, with coal contorted in deep zigzagging seams, makes it prohibitively expensive to extract.

In the West, coal is much younger and softer. It was created only about 55 million years ago, during the late Paleocene Epoch. At the time, North America was still recovering from the impact of a giant asteroid on Mexico's Yucatán peninsula. The asteroid had not only killed off the dinosaurs but also devastated forests and emerging flora. The first plants to recolonize the earth were huge ferns, which soon gave way to modern-looking trees, including relatives of the bald cypress and dawn redwood. At about the same time, in a dramatic geological event known as the Laramide revolution (geologists still aren't sure what triggered it), the Rocky Mountains jumped out of the flatlands. The pressure of this upward thrust caused low-lying basins to flex and sink and created a broad network of wandering streams and lush, soggy bottomland in what is now northeastern Wyoming and southern Montana. The climate

was hot and wet. Redwood and cypress trees thrived in the swamps, creating vast peat bogs. Water and mud ran off the rising Rockies, periodically covering the swamps, but they persisted for 10 million years, ending only with the abrupt drying and cooling of the climate that marked the beginning of the Eocene Epoch.

Most Paleocene coal, such as that found in Wyoming, is sub-bituminous or lignite. This younger coal is much lower in heat value than the higher-ranked coal in the East. But because most western coal was created in freshwater swamps, it is also generally lower in sulfur than eastern coal, a stroke of geological fortune that has given western coal a big advantage in the energy market. In addition, whereas the best eastern coal seams are eight to ten feet thick, the coal beds in the Powder River basin are ten times thicker — and that's just around the edges of the basin. Out in the middle, lurking several thousand feet below the surface — far out of reach of today's coal miners — is an immense coalfield known as "Big George." From drilling samples, geologists estimate Big George to be two hundred feet thick — one of the single richest coal seams in the world.

America's great bounty of coal was no secret to early settlers. Unlike petroleum or natural gas, which pools in reservoirs deep underground and migrates through fissures and fractures, coal rises and falls with the folds of the earth in predictable patterns. Often it literally outcrops to the surface (where it can catch fire, burning underground for hundreds, if not thousands, of years) and can be harvested with even the most primitive tools. That's one reason coal was put to use as early as the 1300s by Hopi Indians to cook and to bake clay pottery, while oil remained a mystery until the industrial revolution was well under way.

In 1673, the French explorer Louis Joliet and the missionary Father Jacques Marquette, the first Europeans to travel down the Mississippi River, saw coal in the river bluffs near what is now Utica, Illinois. In the 1750s, a Philadelphia mapmaker who was surveying the Ohio River valley noted that along with other riches in the valley, "coal is also in abundance and may be picked up in the beds of the streams or from the sides of the exposed hills." Anthracite was discovered in eastern Pennsylvania in 1790, legend has it, when a hunter named Necho Allen was camping for the night under a rock ledge in the mountains. After building a campfire, Allen fell asleep, then awoke with alarm because "the mountain was on fire." Later, he realized he had built his campfire on a coal outcrop. Out west, coal was equally apparent. In 1874, a newspaper reporter who was traveling with the U.S. Cavalry as they chased Crazy Horse across northern Wyoming noted that "the entire section of the valley is a huge coal bed, one of the most extensive in America . . . Some day, I thought, when the Sioux are all in the happy hunting grounds, this valley will rival the Lehigh of Pennsylvania."

Because America's supply of coal was assumed to be so vast, the first attempt to quantify its reserves didn't come until 1909, when the coal industry was near the peak of its powers, and the question naturally arose how long the supply of this fuel that was so crucial to industrialized life would last. Geology was a rough art in those days, accomplished mostly on horseback and based as much on intuition as hard science. But after much study, geologists Marius Campbell and Edward Parker of the U.S. Geological Survey (USGS) estimated that the United States had a little over 3 trillion tons of coal. Of that, about two thirds, or a little less than 2 trillion tons, was "easily accessible or mineable under current conditions." This was music to the ears of early industrialists, of course, and went a long way toward establishing the dream of eternal coal in the American psyche.

The 1909 study was updated over the years, but it wasn't superseded until 1974, when Paul Averitt, also a geologist at the USGS, published a revised estimate of America's coal reserves. By the early 1970s, coal was viewed very differently than it had been in 1909: it was clear that coal's glory days were in the past. In addition, America was facing its first energy crisis, and politicians and business leaders were faced with difficult strategic decisions about the country's energy future. The subtext of Averitt's study is modest and practical: Does America have enough coal to last until it can be supplanted by nuclear power, solar, and other renewables?

Although Averitt used data from the 1909 study in his paper, he also had access to a vast amount of new information about coal that had been accumulated by mining and oil-drilling companies. In addition, he considered factors that had been ignored in the 1909 study, such as the thickness of the coal seams, the amount of earth that needed to be moved to get to the coal, and the general quality of the coal. His conclusion: the amount of coal that was suitable for mining — what he identified as "the reserve base" — was only about 483 billion tons. When you considered losses due to mining operations, the rank and quality of the coal, and other restrictions, Averitt estimated that only about 50 percent of the reserve base, or about 243 billion tons, was recoverable. That was a long way from the 2 trillion tons in the 1909 study, but it was hardly alarming: at the rate America was burning coal in 1973, there was still enough easy coal left in America to last four hundred years.

Almost before the ink on Averitt's study was dry, it became clear to many geologists that Averitt hadn't gone far enough. Among other things, he had failed to make allowances for the sulfur content of various coals, which, since the Clean Air Act was passed in 1970 limiting sulfur dioxide emissions from power plants, had a huge impact on the coal markets. In high-sulfur coal regions such as Illinois, Ohio, and central Appalachia, demand plummeted; in low-sulfur regions such as Wyoming, it boomed. Clearly, the market was far more subtle than the science.

In 1986, the USGS began a pilot project with the Kentucky Geological Survey to attempt a more precise accounting. Instead of surveying the entire state, the USGS focused on one quadrangle (about sixty square miles) in the Matewan coalfields of southeastern Kentucky, one of the most historically important regions for the coal industry in the state. Geologists looked closely at the real-life restrictions on mining: state and national parks, roads, towns, proximity to railroads, coal quality, losses during mining operations, and geological limits such as rock intrusions and narrow coal seams. The result: of the 986 million tons of coal in the quadrangle, only about 30 percent of it was potentially mineable.

Over the next couple of years, the USGS studied about twenty other quadrangles in West Virginia, Kentucky, and Virginia. They all showed similar results: when you factored in obvious restrictions, far less than 50 percent of the coal that Averitt had estimated as "recoverable" was really available for mining. But these studies, comprehensive as they were, still left out one key factor in determining how much coal was really available: economics. Nobody mines coal for fun, after all. The important question is not how much coal America has, but how much of it can be mined at a profit given market prices.

In 1989, the USGS brought in the U.S. Bureau of Mines, an expert at the engineering and economics of coal mining, to add yet another layer of reality to the coal assessments. The bureau started again with the Matewan quadrangle in Kentucky. Headed by a young geologist and engineer named Tim Rohrbacher, the bureau's team used census data, mine maps, and other information to determine that at $25 a ton (about the price of coal when the study was completed), only 7 percent of the coal in the quadrangle was economically recoverable; at $30 a ton, 22 percent was economically recoverable. At the conclusion of this study in 1993, Rohrbacher warned that the Matewan area could be mined out in as little as seventeen years. "If similar results are found in subsequent investigations," Rohrbacher wrote, "a strong argument can be made that traditional coal producing regions may soon be experiencing resource depletion problems far greater and much sooner than previously thought." In later studies of coalfields from Illinois to Colorado, Rohrbacher came up with remarkably similar results: only about 5 to 20 percent of original coal resources were available for mining at current prices. Even in the mighty Powder River basin, in the quadrangle that Rohrbacher examined, only 11 percent of the coal was economically recoverable.

Rohrbacher, who is now employed by the USGS, is at work on a national reassessment that will be completed in five to ten years. But the work he's published so far underscores an obvious truth: the often-quoted estimate that we have 250 years' worth of cheap coal left in America is a gross exaggeration. Rohrbacher points out that the EIA's optimistic estimate of recoverable coal reserves is still based on Averitt's 1974 study, which is not only more than thirty years old but also is itself based on reports from state geologists that are fifty to sixty years old. Averitt's numbers have been massaged a little by statisticians, Rohrbacher says, "but statisticians are like car salesmen — first they ask you what number you want, then they figure out a way to come up with it."

Even the EIA admits the numbers are imprecise. As it turns out, there is exactly one person, an overworked sedimentary geologist named Rich Bonskowski, who is in charge of coal numbers at the EIA. He admits that it bothers him when he hears coal industry executives — not to mention the president of the United States — talking publicly about 250 years' worth of coal reserves in America. "I'd like to be able to bring sober assessment to those numbers," Bonskowski explains, "but we just don't have the resources." Not surprisingly, coal lobbying groups are even looser with their facts than the EIA. Among the most notorious is the West Virginia Coal Association. The EIA claims there are 33 billion tons of coal left in the state; the coal association boosts it up to 53 billion tons. Both numbers, says Nick Fedorko of the West Virginia Geological Survey, are "fraught with problems." A more realistic accounting of recoverable reserves, Fedorko says, is 9 billion to 19 billion tons. "And even that," he admits, "may be optimistic."

In the 1970s, the depletion of the earth's resources was widely predicted, and a lot of smart people ended up looking pretty silly when they failed to anticipate how good engineers would be at figuring out ever more efficient and economical ways of getting coal, oil, and gas (among other things) out of the ground.

In the early part of the twentieth century, coal mining progressed largely by replacing men with machinery: the picks and shovels were banished, replaced by mining machines that did twice the work in one third the time. During the past thirty years, increased productivity has largely been driven by the speed and size of the machinery: draglines — huge, cranelike earthmovers with long booms and buckets large enough to pick up a small house — and haul trucks have gotten bigger, conveyor belts have gotten faster, and coal trains have gotten longer and heavier. Bigger, better equipment has allowed coal companies to expand the size of their operations. In Wyoming, as well as in parts of Appalachia, mines now sprawl over thousands of acres. This new equipment also gave birth to mountaintop removal mining. Instead of tunneling after coal, which has always been slow, dirty, dangerous work, it became more economical to strip away the mountain; haul out the coal with giant trucks; and then pile up the old dirt into something resembling what was there before, toss some grass seed on it, and call it a job well done.

Big Coal's most valuable tool is not bigger, better haul trucks, however. It's ANFO — ammonium nitrate/fuel oil. ANFO is a high-tech explosive that is used in big strip mines all over the world, as well as by terrorists such as Oklahoma City bomber Timothy McVeigh. Instead of digging out the coal, it's much more efficient to blast the earth around it away. Coal mines are responsible for about 70 percent of the 2.5 million tons of industrial explosives that are detonated in America each year. At times, there are so many blasts going off in the Powder River basin that the region could easily be mistaken for an air force bombing range. Blasting engineers like to tell a story about how Russian scientists picked up suspicious tremors on their seismographs a few years ago and accused the United States of secretly testing nuclear weapons in northeastern Wyoming. No, our diplomatic staff explained, we're just mining coal.

At Cordero Rojo, I asked the blasting supervisor, Gary Jerke, if I could watch an ANFO blast, and he happily agreed. Jerke is stocky and broad-shouldered, with a salt-and-pepper beard and a scuffed white hardhat that is plastered with old stickers from blasting product manufacturers. One morning, we pulled up on a broad, flat area above one of the mining pits, where orange detonation cord zigzagged over dusty gray mudstone. Beneath the cord, in an area roughly the size of a football field, about 180 holes had been drilled in the ground, each fifty feet deep and ten inches wide. Each hole had been filled with ANFO the previous afternoon and was ready to go. Timothy McVeigh used only 3,800 pounds of ANFO to blow up the Murrah Federal Building in Oklahoma City. Buried here was 55,000 pounds. By Wyoming standards, it was a small load.

Jerke immediately began arming the remote-control detonator. Helping him was Paul Hazlet, also a blaster at the mine. "We're trying out a new kind of detonator today," Jerke explained. He connected the end of the blasting cord to the detonator box, then opened it up and showed me a small steel pin inside. "When I push the button, that pin makes a spark, which ignites the blasting cord."

The whole explosion is elaborately choreographed, with a 130-millisecond time delay spliced into the cord between every two holes. "The goal here," Jerke told me, "is not to blow the place to hell. We just want to fluff up the dirt a little and make the coal easier to dig out."

Jerke and Hazlet double-checked the connections to the detonator, then closed a plastic lid and set it on the ground. "Okay, we're armed and ready," Jerke said.

Jerke handed a small orange box with an antenna on it to Hazlet. It looked like something you might use to fly a model airplane. Then Jerke drove off to observe the blast from a safe distance. I jumped into another truck with Hazlet, a friendly, rugged-looking guy with red hair and ragged coveralls. As he drove, he told me he'd been a blaster in Wyoming for ten years. "Still got all my fingers and toes," he joked. The detonator sat on the seat between us like a box of candy.

We parked on a level spot overlooking the blast site and stepped out of the truck. Hazlet handed me the orange box. "All you have to do is flip the switch," he explained. "But not until I tell you to."

Hazlet radioed Jerke and told him we were in position. There was much radio chatter as Jerke checked with everyone to make sure the roads and the blast area were clear. Then a warning siren sounded.

Hazlet reached over and turned a key on the box. A light blinked. "Okay, it's all set," he told me. "When you hear 'Fire in the hole,' throw the switch."

Jerke on the radio: "Thirty seconds to blast."

I stared at the box, my finger poised on the toggle.

"Don't look down when you throw the switch, or you'll miss it," Hazlet warned.

I looked up.

"Fifteen seconds to blast."

I wondered, briefly, if I would feel bad about doing this.

Jerke: "Fire in the hole."

I flipped the switch.

The explosion arrived in three parts. First, the earth lifted like a giant blanket being shaken out. Second, the ground beneath my feet trembled. And finally, I heard a surprisingly muffled boom.

After the dust settled, Hazlet and I drove back down into the pit. I was buzzing with adrenaline — cracking open the earth certainly perks you up.

Soon Jerke and others arrived. We inspected the devastation — large continents of mudstone strewn about, lifted and fractured, broken up. A job well done, Jerke proclaimed. Within an hour, a big shovel would move in and begin uncovering the coal. Within twenty-four hours, that coal would be loaded into a railroad hopper and rolling over the prairie toward a big coal burner somewhere in America, where it would, as Jerke put it, "feed the beast."

That morning at Cordero Rojo, I understood why some people are so optimistic about coal's future. The amount of coal we can extract from the earth is limited only by the size and frequency of the ANFO blasts we're willing to detonate. As long as we're willing to blow the hell out of the place, there is no coal seam, no matter how remote or how deeply buried it may be, that can't be mined.

If all of America looked like the Powder River basin, it would be hard to mourn the loss of a few square miles of prairie in exchange for cheap, abundant energy. Unfortunately, the Powder River basin is a unique place. In the rest of the country, ANFO blasts are more like artillery shells in an industrial war. And the people who are getting the worst of it aren't the lobbyists or legislators in Washington who push for more coal burning. They're the people who were unlucky enough to have built homes and raised families above the remaining coal seams.

No matter how you cut it, coal mining is vastly more invasive than oil or gas drilling. Done right, inserting a drill bit deep into the earth to tap a pool of oil or gas is minimally destructive. But mining coal is always brutal. It's hard on people and it's hard on the land. In some cases, this brutality can be a virtue: in a big strip mine, you can extract a lot of energy per acre of land disturbed. And some coal companies, including Kennecott Energy, which owns Cordero Rojo, have become much more sophisticated about how they reclaim land after they're finished mining. But coal mining, by its very nature, is a destructive, dangerous operation that does not fit well with civilized life. Just ask the parents of three-year-old Jeremy Davidson.

On the night of August 20, 2004, his parents tucked him into his crib in their small house in Inman, Virginia. A short time later, a bulldozer working at a strip mine above them pushed a six-hundred-pound boulder over an embankment. It kept rolling, bounced down the hill, and crushed Jeremy as he slept.

Fifty years ago, children like Jeremy didn't sleep immediately below big strip mines. Most coal mines were underground, and they were located in remote areas, keeping the messy reality of mining operations far removed from most people's daily lives. But dwindling reserves, combined with expanding population, are changing that. In Pennsylvania, miners now routinely tunnel under roads and houses, causing the land above to subside, breaking windows, cracking foundations, fraying nerves, and sometimes rendering houses uninhabitable. In eastern Ohio, Bob Murray, a well-known and politically connected coal operator, sparked a fierce battle with local residents over his plans to mine beneath the most significant old-growth forest in the state. In Pike County, Kentucky, dozens of families were recently evacuated from their homes because of the danger of flying rocks caused by blasting at a strip mine nearby. In West Virginia, overloaded coal trucks terrorize small towns and have been involved in numerous fatal accidents.

If America's dependence on coal grows, so will these kinds of conflicts and confrontations. The coal industry tends to see people who live near mineable coal seams as people who are standing in the way of progress, as if their right to profit from digging out these ancient black rocks supersedes every other right, including the right of future generations to imagine what the Appalachians looked like before they got leveled. The issue is not really whether we have enough coal to provide enough electricity to keep our air conditioners cranked up. We surely do. The issue is, how big a part of America are we willing to sacrifice for this privilege?

In West Virginia, residents can see the topography of the state changing before their eyes. Not long ago, I spent an afternoon with Larry Gibson, a local resident whose home is on a mountaintop that is surrounded by a big mountaintop removal mine. Draglines and shovels have already carved away much of the land that surrounds his property, which has been in his family for three hundred years, leaving him living in a small oasis of trees in the middle of an industrial zone. Streams where Gibson's great-grandfather fished and swam are now filled in; hills he hiked with his father are flattened. Gibson, understandably, has taken it personally and keeps a .38 under the seat of his truck to defend himself against angry coal miners who don't like his very vocal objections to the way they conduct business. "People say, 'Larry, what are you so angry about? America has to get electricity from somewhere, doesn't it?'" he explained. "Then I take them out here and show them this, and they understand."

Gibson and I stood together on a bluff near the family graveyard, where we could look down into the vast terraced mining pit below. A distant boom echoed through the hills; the ground rumbled, and dust plumes drifted over the trees. I recognized the sound. The mountains were coming down, one load of ANFO at a time.

Chapter 2

Coal Colonies

EARLY ON A COLD, rainy December morning, sleepy but excited children and their sleepy but less excited parents began to line up outside an old brick furniture store in Madison, West Virginia. Madison is a small town of about 2,600 on the Little Coal River about an hour southwest of Charleston. The town is best known as the gateway to the southern coalfields, once called West Virginia's billion-dollar coalfields because they were so vast and so rich. The legacy of Big Coal is visible everywhere here, from the statue of the coal miner in front of the Boone County courthouse to the thin layer of black dust that coats the railroad tracks on Main Street. Southern West Virginia is still the most productive coal region in the state, but its glory days are long past. Like most coal towns, Madison feels like a harsh, unforgiving place, where just getting by is an accomplishment.

But not that morning. That day, the biggest coal company in West Virginia, Massey Energy, was holding its 2004 Christmas Extravaganza. Madison is practically a company town for Massey — several of its biggest strip mines are in the hills nearby, and the $3.1 billion company employs some eight hundred workers in the area, making it by far the largest employer. Massey employees and their spouses had spent most of the last week getting ready for the Christmas Extravaganza, brightening up the old furniture store with a Christmas tree, tinsel, and holiday cheer. Santa Claus would be there, along