crude

THE STORY OF OIL

Sonia Shah

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PREFACE

For the Love of Oil

> Oil creates the illusion of a completely changed life, life without work, life for free. . . . The concept of oil expresses perfectly the eternal human dream of wealth achieved through lucky accident. . . . In this sense, oil is a fairy tale and like every fairy tale a bit of a lie.
>
> —Ryszard Kapuscinski[1]

AT ONE TIME, humans cloaked their lives in the flesh of trees. Babies cried in their wooden cribs under wooden roofs while wood fires burned.

As the forests died, we threw sooty lumps of coal onto the life-sustaining fires that kept us warm and cooked our food. In oil, though, we encountered a more powerful and seemingly plentiful accumulation of energy than any other then known. If our quest as living creatures could be said to exist within that margin between the amount of energy our hot-blooded, brain-heavy bodies needed and the amount we could suck out of the environment around us, crude's riches liberated us. Once we found it, we consumed it in great mouthfuls, barely coming up for breath.

Oil's initial bounty in the fertile, mineral-rich United States, coupled with American entrepreneurialism, spawned an international oil industry with a peculiarly American nature. John D. Rockefeller created the model, one built on conglomeration, control, and ruthlessness. In the beginning, drilling for oil was a backyard affair, requiring about as much capital, technology, and know-how as cutting a cord of wood. People scooped the stuff out of blackened

rivers with rags and buckets. But as the stores of oil diminished, the drills were forced to claw deeper and farther afield. The business of extracting oil grew ever more lavish and expensive, and the companies that could afford to profitably continue swelled larger and larger. While elsewhere nations enclosed themselves protectively around oil's luscious accumulations under their parched soils, the Western oil industry wildly traversed the globe, ravenously hunting for more.

Whole nations of people, amazed to find black gold under their lands and shores, open their doors to the Western oil companies that will bring in the pipes and pumps to siphon the oil away. While they dedicate their economies to feeding oil-burning machines sputtering in distant lands, their own self-sustaining communities and economies atrophy. In Indonesia, Nigeria, Colombia, and elsewhere, the impoverished crowd outside oil facilities' walled compounds.

Within a century of drilling the first oil well in 1859, crude oil and the products and machines it makes possible had seeped into virtually every crevice of Western society. Today, oil and its progeny make cars run, planes fly, houses warm and lit, hospitals sterile, and supermarkets stocked with fruit and vegetables. Strapped into steely, oil-fed motors, soft, breakable human bodies gloriously extend their reach and power. Newborn babies slide from their mothers into gloved hands, are swaddled in petropolyester blankets, and hurried off to be warmed by oil-burning heaters. The few metal and wood products that remain today are extracted by oil-powered machines traveling on oil-covered roads. They arrive packaged in oil-made plastics.

One-sixth of the entire global economy is dedicated to the staggering effort of harvesting oil from its uneven accumulations within the earth's crust. Yet although oil drenches Western societies—Americans alone gorge on no less than three gallons every day—the average Asian or African receives few of the benefits of the planet's crude.

As the lush accumulations of the planet's crude diminish, oil companies enlist the best minds of scholars and the blood of soldiers to

fortify their sprawling tangle of arteries pumping oil to the world's machines. Up in the air, the century's explosion of carbon from the planet's crust hangs over us ominously. Still, most oil companies are convinced they are doing the right thing.

"Everyone at this company works for the general good," avows ExxonMobil's Lee Raymond. "And I'm the general of that general good."[2]

Others feel differently. Oil is "the excrement of the devil," spat OPEC co-founder Juan Pérez Alfonzo.[3]

This book tells the story of oil from its birth hundreds of millions of years ago, when ancient creatures floating in sun-dappled seas sucked carbon out of the air, through to its maturation entombed deep underground. It recounts the modern tale of crude's abrupt exhumation, the battle to control its riches, and its effect on the environment out of which it came.

The giant Western oil companies don't own access to the majority of the world's oil, which is controlled by governments and developed by their state-run companies. Nor do they produce the majority of the world's oil. But they do make the most money from oil, and their deep pockets and continuing quest for profit mean that they shape the way the entire planet develops and markets oil. They wield influence on the world's most powerful Western countries and even more on the vulnerable penniless ones, dictating how we will exploit and distribute the planet's precious finite hoard of oil, one of the most versatile, energy-intense substances ever known, and with consequences far beyond oil itself.

INTRODUCTION

Oil Is Born

THE STORY OF oil is written on a time scale that humans can scarcely grasp, but it starts with something innocuous and seemingly peripheral: the slimy dregs at the bottom of the sea.

The outer crust encasing the earth is just 100 to 200 kilometers thick, a mere fraction of the way to the center. It is like a cracked eggshell, fragmented into about eight large plates and many smaller ones. Along with the burning star that is our sun, the Earth is primarily energized by its own interior, a hot core left over from the planet's creation more than 4 billion years ago. The fury of that heat becomes apparent when volcanoes erupt, vomiting up the innards of the planet. That heat drives the plates into constant slow motion—as much as ten centimeters a year.[1]

Throughout Earth's 4.5-billion-year history, these moving plates press against each other, forming mountains; tear apart, leaving huge depressions; slip under and slide past each other. Their rocky surfaces bear the scars of their journeys. Ice scrapes on rocks in the middle of the burning Sahara Desert and tropical rainforest plants buried in the middle of North America allow geological detectives to unravel the mobile plates' ancient pathways.[2]

A watery shroud swathes the cracked crust of our gigantic ball of heat, sloughing off the outer layers and sending them into motion. The water enveloping the planet in clouds, oceans, lakes, rivers, groundwater, and glaciers constantly circulates, melts, rains, freezes, and evaporates. The frenzy of water's activity along the surface of the earth shapes its face, eroding mountains, cutting grand canyons, slowly slipping ever downward through the tiny spaces between the crumbs of soil into the rocks below.[3] When the weather turns cold, the water inside the rock freezes, expanding

and shattering the rock. All of these processes slowly but surely break the mountains down.[4]

The products of that weathering and erosion, sediments, slip down the land, settling in puddles, washing into streams, and finally slipping into the sea. Rivers swirling with sands and sediments rush toward the ocean. As they approach the sea, the rivers' flow slows, and the suspended sediments start to sink. On the floor of the sea, the layers of sediment slowly build up. The bottom ones get buried under progressively more and more weight and eventually turn hard and compressed. They become rock.

The ocean teems with tiny crustaceans, worms, and algae, microscopic life on which the entire food chain hangs. The seas are cloudy with them. But among the three kinds of sea creatures—the ones fixed on the bottom, like corals; the ones swimming around, like fish; and the tiny creatures that simply float with the currents and tides; the tiniest are by far the most prolific, producing up to 80 percent of the total organic matter in the ocean.[5]

Those hordes of miniscule marine creatures are called plankton. The term "plankton" refers less to a specific kind of organism than just a strategy: those creatures that are too small or weak to swim well and who thus choose to float along the currents and tides, hoping for the best. Phytoplankton, microscopic one-celled photosynthesizing organisms, are the engines of the sea. They form the basis of the food chain under the water by feeding on sun and carbon dioxide, and then raining down to sustain the creatures below, swallowed in bits by other plankton or in great mouthfuls by those that swim.

The goal in life for plankton is not to sink. They must stay within the layer of the water that gives them enough light and warmth, and this struggle tends to keep them quite minute. In order to avoid predators, they hide by making themselves transparent or schooling together in great clouds or by simply becoming smaller

and smaller. Particles of food suspended in the surrounding water nourish them.[6]

Especially prolific are the diatoms, half-plant half-animal creatures that reproduce by division, and which can lurk for years, undead, waiting for the right opportunity to come alive again. The longest ones measure eighty micrometers. After they die, their glasslike shells sink to the bottom, joining the discarded fish bones and teeth littering the seabed, infused along the coasts with incoming sediments from rivers.[7] The tiny shells of these and other single-celled creatures fall to the bottom and mix with the mud to turn into what geologists call carbonate "ooze."[8]

Plankton remains and other sediments can blanket the sea floor with about .1 millimeter of organic rubble a year. Over 10 million years, that adds up to an entire kilometer. Indeed, the accumulated remains of coccoliths, tiny shelly spheres about ten micrometers in diameter,[9] formed most of the towering white cliffs that loom over both sides of the English Channel.[10]

Most of the organic material that starts sinking to the bottom never reaches the seafloor. It gets eaten by fish or demolished by burrowing bacteria. But in fits and bursts at specific times and locations, organic sediments are preserved unrecycled and are buried untouched. If conditions are precisely right for those silty layers to accumulate, they may, in time, turn into oil.

The slime in question, this preancestor to oil, is packed with carbon.

Carbon is the building block of life, the stuff plants turn into food and that we breathe out as carbon dioxide. It is the black sooty stuff that makes up coal and graphite along with the hardest material on earth, glittering diamonds, as well as countless other substances when partnered with other elements. An entire branch of scientific inquiry, organic chemistry, is devoted to studying carbon.

Billions of years ago, carbon-containing meteorites and other small, solid celestial bodies bombarded the earth, steadily increasing the amount of carbon on the newborn planet.[11] There are about 49,000 metric gigatons[12] of carbon on Earth today,[13] making it the fourth most plentiful element in the universe after hydrogen, helium, and oxygen.[14]

Carbon circulates around our planet, sinking into the earth, spewing out in volcanoes and wafting up into the atmosphere. Seven hundred and fifty gigatons of carbon hang in the atmosphere, accounting for less than 1 percent of the world's carbon. At those lofty heights, carbon envelops the planet in a warming shell, letting heat in but not out.[15]

The vast majority of the world's carbon—more than 30,000 gigatons—resides in the world's oceans. (About 10,000 gigatons are locked in methane hydrates, a crystallized form of methane that forms under cold deep seas.)[16] The ocean and the airs above it conduct a gentle, give-and-take conversation with carbon, whispering the element back and forth depending on which side's concentration is greater.[17] Carbon dioxide dissolves in seas and ocean currents carry the carbon-laden waters down into the dark depths. Phytoplankton also turn the carbon from the air into food, storing it in their watery tissues. Other hungry creatures take with their bite of phytoplankton all of its stores of carbon, passing the carbon along the food chain.[18]

A similar process occurs on land as plants transform carbon into food and living tissue by photosynthesis. Animals eat the carbon-rich plants, growing their bodies and exhaling the byproducts, carbon dioxide, into the air—where plants can once again breathe it in. In total, forests and the rest of terrestrial life hungrily eat, breathe, and exhale another 3 percent of the world's carbon.

When fused with hydrogen, carbon repels water, which is why oil won't mix with water. Oil, along with natural gas and coal, is a hydrocarbon, so named because it consists of hydrogen and carbon. The simplest oil molecules are long chains of carbon atoms with hydrogen atoms hitched along the sides and ends of the molecules. A single carbon atom with a few hydrogens attached to it is methane, a light gas. A chain of three carbons is propane; four carbons is butane. A chain of eight carbons is octane. As the chains and rings of carbon get longer and longer, they stick to each other better. The hydrocarbon gets thicker. Thirty-carbon chains are waxy; refiners string even longer chains together to make plastics.[19]

For creatures like plankton that are composed mostly of water and live in water, a barrier of water-repelling material is crucial. It is what separates them from the sea that surrounds them, the thin barrier between the animate water inside and the inanimate water outside. Not surprisingly, a key component of planktonic cell membranes is made of chains of hydrocarbon molecules. If you zoomed in on the cell membranes of marine algae you'd see it: a chain of fifteen or seventeen carbon atoms strung together, holding the incoming waters at bay.[20]

Hydrocarbon-rich plankton corpses pile up in the sediments at the bottom of the sea. As more and more rich organic sediments collect on top, each layer is buried deeper under the subsiding seabed. When the sediments have sunk several kilometers underground, their compaction expels much of the water. Because much of the organic material comes from plankton, and minus water, plankton contains water-repelling hydrocarbons, the layers become rich in hydrocarbon. Over millions of years, the sunken, hydrocarbon-enriched layers harden, turning into thin sheets of dark chocolate brown or black rock.[21] If you took a chunk of it and put it under a microscope, you

might see bits of shell, pollen, and even whole microorganisms fossilized there in the hardened rock.[22]

Once buried deeply, at least seventy-five hundred feet down, these sedimentary layers will turn into a hydrocarbon-impregnated shale or mudstone. Under increasing pressures as they get closer to the center of the earth, the organic-rich layers are gently heated at temperatures of around 180 degrees Fahrenheit, as warm as a hot cup of tea. Cooked over millions of years, the hydrocarbons in the rock mature. The heat splits the large molecules into progressively smaller ones and the hydrocarbons in the rock become lighter, less viscous, and much more volatile. The water-repelling cell membranes of single-celled marine creatures get squished and simmered into oil, which now infuses the shale, or "source rock" as petroleum geologists call it, in drops and blobs.[23]

If the rocky layer continues to descend into the earth's crust, going deeper than eighteen thousand feet, the pressure becomes too great, the layers too sunken, and the heat too intense. The oil "cracks" into the smallest and lightest molecules of all—methane, or natural gas.[24]

Just over a fifth of the world's carbon has been entombed this way, resting in the earth's crust.[25] Before people started to unearth oil, geologists from the U.S. Geological Survey figured around 2 trillion barrels[26] of carbon-rich oil were secreted underground. By unleashing oil from its silent tomb and burning it, we send the carbon locked in oil's hydrocarbons back into the atmosphere. During the last ice age, the carbon blanket in the atmosphere was only half as thick as it is today. Now, as more carbon wafts up to weave itself into that blanket, it thickens, keeping the planet warmer and warmer.[27]

If the world's oil all resided underground in deeply buried layers of shale, that carbon-rich, plankton-blessed rock, people would have

never known about it. Part of the story of oil is how it moves and gets trapped in places where humans can get at it.

Oily shale and mudstone source rocks are full of oil, it is true, but it is practically impossible to get the oil out of that sludgy rock, as it is too dense. Of course, people have tried. There's a massive amount of oily shale in Colorado, deposited by a gigantic lake that covered parts of Utah, Colorado, and Wyoming more than 60 million years ago. Today, the lively lake is gone, but its oily sediments remain unburied, what one petroleum geologist dubbed an "unborn oilfield."

Chunks of Colorado's rich shale burn almost like coal, as railroad workers discovered when they used the rocks to encircle their campfire. There are tons of oil in that shale; if people could get it out, the amount would be roughly equal to all the world's conventional oil.[28]

In the 1980s, Exxon, desperate for a new source of oil, spent over $1 billion trying to get oil out of Colorado shale, ultimately abandoning the project when the price tag zoomed to $8 billion for a measly fifty thousand barrels of oil a day.[29] To deliver the unborn oil, the company would have to mine the rock, crush it, and then heat it, producing more waste than would fit into the hole they dug to mine the rock to begin with.[30] The procedure is also highly polluting, releasing three to six times more greenhouse gases into the atmosphere than conventional oil production, according to Greenpeace, which has campaigned against shale oil development.[31]

Instead, people look for the places where geological forces have moved the oil out of the shale into a rock more suitable for drilling. That happens when the shale layers get squeezed, as the constantly moving plates start pushing and pulling on the rock. Millions of years of such pressure on the rocks squeezes the oil out, buoyed by its own relative lightness. A migrating stream of oil can travel long distances, sometimes more than a hundred miles.[32] Where does it go? Crushed under tremendous pressure, under thousands of feet of shifting layers of rock, the oil searches for the easiest route out, through the tiny fractures and pore spaces in the rocks that suffocate

it. It is a tortuous path, twisting and turning amid the miniscule gaps, aiming for the sun.[33]

The rock layers are heavy, but not all of them are very dense. Say the migrating oil encountered a rock made from a buried beach of white fine sand that had fused together into a porous sandstone. Even under great pressure, up to a quarter of the volume of that fine-sand-beach-turned-rock will be empty space. The even-sized sand grains stack upon each other like a pile of ping-pong balls, leaving plenty of room between them. Or say the traveling oil met up with limestone that had been lifted back up to the sea and exposed to fresh water again. The acidic water would have dissolved passageways for itself as it trickled through the rock, leaving behind a network of tiny connected veins. Or it could run into a buried reef, with its countless tubes and passageways created by living creatures, likewise riddled with connecting holes.[34] Such a porous rock will start to soak up the oil like a sponge. The oil-saturated sandstone or limestone becomes what is known as a "reservoir rock."[35]

The oil-soaked sandstone, this oily sponge, must also have a lid on it. Otherwise, the oil will keep on trickling out, dispersing itself over vast areas and becoming so spread out it will be impossible to collect. Something impermeable must sit on top of the sandstone, forming a kind of seal for the migrating oil. The very structure of the rocks may change in a way that could trap the seeping oils. An impermeable rock layer, perhaps more shale through which water and oil won't flow, might be shifted into place above a stream of migrating oil, curling over it like an overturned soup bowl. Over millions of years, those curved layers (called "anticlines" by geologists) can capture the oil in the porous rock layer below. Natural gas from deeper layers may drift upwards and also become trapped above the oil, along with water migrating amidst the rock.[36]

Sometimes, if there are multiple layers of shale, sandstone, and salt, over and over again, the salt will tend to float upwards, because it is lighter than the other layers above it. The bulging salt layers will push up the sedimentary layers above them, forming a kind of

dome. When the shale's oil is squeezed into the sandstone, the dome will bar its further movement. Anticlines formed by salt domes are excellent traps for oil.[37]

However, years of erosion can occasionally wear down the rocks that entomb such oil-filled traps, bringing an entire oilfield to the surface. It happened in Alberta, Canada. All of the light oil and gas quickly dispersed into the air, leaving behind only a tarry, oily sludge—the infamous Alberta tar sands, a dead oilfield to shale's unborn one.[38]

A worthwhile oil reserve, then, must have thick layers of oil-rich source rock, porous reservoir rock, and an impermeable "cap" rock, all in the right position to form a trap, and pressurized and heated to just the right conditions. It is an elaborate sequence of events that takes place over millions of years, enlisting the carcasses of billions of creatures, the rising and falling of seas, and the shifting of tons of rock. All told, earth has given birth to 2 trillion barrels of oil, a labor that appears as improbable as it is quite awesome in scale.

Kenneth Deffeyes is a retired professor of geology from Princeton University, a cheery rotund man who grew up in the oil patch. His fondness for the oil he's spent his life scrutinizing, for Shell, Princeton, and the various oil companies for whom he's consulted, compels him to roll down his car window when he drives by a refinery, in order to take a deep breath. The story of oil's unlikely ancestry appears to fill him with glee. "If any one of these conditions is missing, tough luck. If one of them is only partially developed, you get a small oilfield," he says. "The chances of rolling a seven with the dice six times in a row is rather small!"

"So it does look like accidents on the highway, where you get a lot of little fender benders and a few of these giant pileups with forty cars in it," he goes on. "Well, the Middle East is a giant freeway with a forty-car pileup. It is a place where everything was just right."[39]

Around 180 million years ago, a warm shallow sea washed just above the equator, splitting the single continent that had previously covered the earth into two major subcontinents, Laurasia and Gondwanaland. Ancient reef-building organisms slowly built their wondrous reefs in this sea. It's been named the Tethys, as in the mythical daughter of the Greek god of heaven and the goddess of earth who bore three thousand ocean nymphs and all the river gods.[40] The Tethys sent its warm, equatorial ocean currents and its diversity of shelly and fishy Jurassic and Cretaceous life flowing all the way around the globe.[41] Dolphin-like reptiles and sea-going crocodiles cruised its waters, with forty-foot plesiosaurs as kings of its underworld.

Up on the land, dinosaurs stomped amidst the spiky, pineapple-like cycads. Our ancestors among them, the early mammals, were just tiny vermin, "the cockroaches of their day," as paleontologist Michael Benton put it, although we would claim the Tethys' products of that time as our own, much later.[42]

For more than 100 million years, the Tethys sea floor collected rich layers of sediments, as abandoned shells, plankton, and other organic sediments descended gently on the seabed. Then the seas lapping up on the shore receded, leaving behind a salty crust on top of the organic layers. Sands rushed in and buried the salts. This happened over and over again, leaving thick sequences of source rocks, reservoir rocks, and evaporites. Slowly, the layers began to sink, which compressed them into that essence of ancient life, oil.[43] Those sunken sea-bottoms of the Tethys now contain about two-thirds of the world's oil.[44]

Much of it got trapped in the Middle East. Around 15 million years ago, the sea-floor under the Tethys was consumed into the earth, its sediments scraping up onto the surface. The continents of Arabia and Asia that once lined its shores collided. The impact smashed the land, throwing up the soaring, snow-capped Zagros mountains, which lie in today's southwestern Iran. The southwest side of the mountains was left with a huge depression, the Mesopotamian basin, one of

the largest sedimentary basins in the world, where the organic-rich sediments of the now-vanished Tethys came to rest. Meanwhile, the stress of the massive continental smash rippled, folded, and faulted the rock, squeezing the oil out of its deeply buried layers. The oil started to migrate. The long-gone beaches and reefs of the Tethys, buried and turned to sandstone and limestone, sucked up the migrating oils. In some places the salty layers sealed them in salt domes; in others, the stresses folded the sediments, forming huge anticlines that trapped the oil.[45]

With trillions of barrels of crude oil migrating through the twisted crevices in the rocks underfoot, it isn't surprising that some of it managed to find its way to the surface. Some of it would simply vanish, evaporated into thin air. Some would linger, collecting in muddy pools, trickling down cliff faces, or burbling up under rivers, creeks, and seas.[46] Bacteria would feed on the rich hydrocarbons, swirling in black puddles. In tropical seas, bacteria would crowd hungrily around the warm seeps of oil clouding the water, forming mounds later colonized by reef-building creatures.[47]

Newly evolved humans walked out of their ancestral Africa, using the land bridge formed by the crash between Africa and Asia that had swallowed the Tethys, and settled in the fertile valley between the Tigris and Euphrates Rivers. It wasn't long before they found the remains of that ancient rich sea. Its oils were slowly oozing out onto the fertile soils basking in the sun.[48]

The first thing they noticed was the otherworldly sound. Natural gas percolated through the fissures under the ground, sending up a ghostly echo. It sounded to the people above, craning their ears to the earth, like the voices of the gods of the underworld. They found oily pools and gathered some of the strange liquid, divining the future from the shapes that the liquid would make when thrown into water. Soon the stuff was put to more practical use, gummed

onto boats and houses to create watertight seals. The seeps were so plentiful that the Mesopotamians were able to dig up over fifty thousand kilograms of solid petroleum sludge. They found some light liquid oil as well, but deemed it useless. Pliny declared it too combustible and therefore "quite unfit for use."[49]

The Persians filled pots and other vessels with a stinky volatile mix of sulfur and crude oil, which they'd set afire and then hurl at their enemies. The ancient Greeks greased their arrows and lances with petroleum to make flaming torches. By the seventh century AD, the Byzantine Empire had perfected a liquid combustible made primarily of boiled petroleum called "Greek Fire," which set hearts trembling throughout the region for centuries.[50] They used the combustible mixture to fend off waves of attacks from Muslims, Western Europeans, and Russians. Soldiers cavorted with long tubes full of crude, which they would light and throw into their enemies' faces. Muslim states used incendiary warfare—weapons made fiery with oil—to fend off Christian invaders.[51]

Tethys' hydrocarbons inspired godliness as well as aggression. In Baku, the ancient Persian city that is now the capital of Azerbaijan, some of the oil escaped with gusts of natural gas and burned continuously. The Persians worshipped those miraculous everlasting fires. The prophet Zoroaster, born in Azerbaijan or Iran more than two thousand years ago, created a new religion based on fire worship, which flourished as the official religion of Persia for over four hundred years. His followers, the Zoroastrians, tended perpetual fires in their temples. When Muslim Arabs conquered Persia in the seventh century, extinguishing the eternal flames, the Zoroastrians fled to India. Today, 270,000 Zoroastrians in India and Iran pray to the sacred fire five times a day, a modern testament to an ancient wonder, pure combustion spurting out of the belly of the earth.[52]

Oil has become so enmeshed in our lives that, like the air we breathe and the ground underfoot, many of us barely notice much about it, aside from a slightly pungent odor at the pump during the weekly five-minute ritual of refueling the car. But oil, as part of our

planet, its legacy of life, and its capacity for change, is not something we can so easily separate from our own organic earthbound selves, pouring it into our machines at arm's length, noses held.

The way oil is created, its ancient pedigree, its tortuous journey to the places in the earth where we can find it, its elaborate chemistry—all of this makes it precious. Yet, it has rarely been treated as such. Once we encountered oil, we wallowed in it, consuming crude about one hundred thousand times faster than it could possibly accumulate again.[53]

CHAPTER ONE

The Eclipse of Coal

By the mid-1500s, England's forests were dwindling. People needed to feed their fires and they turned to a strange, fiery black rock that they clawed out of the ground. They didn't know it at the time, but the rich rocks they found were the ancient condensed remains of ferns and other plants that had rotted in swamps eons before: coal. Burning it wasn't a great option. The black coals reminded them of the black swellings of bubonic plague. The smoke made them sick. Extracting coal was time-consuming, dangerous, and inconvenient. The mines held poisonous and explosive gases, and were apt to unexpectedly fill with water. But it was better than the alternative: freezing to death among the denuded hills of England.

And so, coal was dug out of the ground to feed Britain's fires, coating the cities with a thick layer of grime and filling the skies with low-hanging dark clouds. By the 1700s, the coal that ran in shallow veins close to the earth's surface was gone. They'd have to dig deeper to get more, risking even worse flooding and explosions.[1]

Continuing to rely on such a difficult, costly fuel source would be risky, possibly even foolhardy. The amount of energy needed to pump the water out of those deep holes that burrowed beneath the water table might be equal to, or even greater than, the amount of energy that the lumps of coal that came out of the ground could pay back.[2] Yet coal was already a business worth fighting for. Mine-owners calculated that they could still profit from bigger and deeper mines, even if they had to foot the bill for more workers and more machines, as long as they could recoup their investments by selling even more coal.

In other words, the more depleted the coal became, the more trouble it would be to get more out and, at the same time, the more coal they'd have to sell to make it all worthwhile. Yet the topsy-turvy formula worked. By consolidating, hiring more workers, and attracting greater investment, coal mining soon became one of the biggest, most capital-intensive industries in Britain.

In 1712 the steam engine was invented and quickly employed to drain the water out of ever-deeper coal mines. The steam engine, "the most wonderful invention which human ingenuity had yet produced," wrote historians, bestowed "the art of converting fuel into useful power for the benefit and convenience of humanity."[3] The additional coal made accessible by the steam engine was used, in part, to fuel the steam engines and the fires that smelted the iron to make the engines. It was a self-sustaining cycle that allowed both coal production and iron production to intensify, driving the price of both down. Soon, the industrial revolution—that frenzied partnership among iron, steel, and coal—was banging along. Britain, with its huge coal reserves, and its formidable Navy kept honed by accompanying the coal convoys down the English coast, sat at the very top of it.

Coal bestowed power in the eighteenth and nineteenth centuries, but it came at a price. Coal's black smoke was so thick that it could be seen hovering over English cities from miles away, in some cases blocking the sun's rays entirely. Londoners, squinting by their sooty windows, switched on their lamps to read the morning papers. Children toiled in the coal-fired factories, and even worse, in the dank, toxic coal mines themselves. "For watching the doors the smallest children are usually employed," noted economist Friedrich Engels, "who thus pass twelve hours daily, in the dark, alone, sitting usually in damp passages without even having work enough to save them from the stupefying, brutalizing tedium of doing nothing." Children dragged themselves homewards after their long shifts in the mines so tired that many were found, hours later, asleep on the road.[4] Deprived of sunlight, subject to poisoned air and explosions, they

died in droves. Most of the poor in mid-nineteenth-century Manchester didn't survive to see their eighteenth birthdays. Those who did aged prematurely. Some of the tragedies that befell coal workers were hidden, for a time, by coal-mine owners who conspired with local newspapers to censor coverage of mine explosions.

Nevertheless, London was affectionately dubbed "The Big Smoke," a smog-shrouded city that Lord Byron romantically described as "a wilderness of steeples peeping on tiptoe through their sea-coal canopy."[5] Painters such as James Abbott McNeill Whistler, Joseph Mallord William Turner, and Claude Monet captured the city's foggy phantasmagoria, and Charles Dickens wrote of coal's "soft, black drizzle." Jack the Ripper stalked his prey under cover of coal's thick brown haze.[6]

Across the Atlantic, a different story was unfolding. People found tons of black coal, but they also found something else, a liquid fuel that would slowly gain in popularity until it overtook coal altogether.

By the 1850s, people in northwestern Pennsylvania had noticed the black grease floating on top of their creeks and springs. Skimming it off the top, or soaking their rags in the oily waters, they used the liquid for the first thing that would come to mind in those rough days: to try to ward off the bewildering array of illnesses that plagued them. At the time, cholera, yellow fever, influenza, and smallpox epidemics ravaged the North American populace. Some entrepreneurial types started selling the oil under the name "Seneca Oil," as a cure for worms, deafness, toothaches, and dropsy.

When set alight, oil's long chains of carbon split apart, releasing the energy stored in their powerful bonds. Afterwards, oil's hydrogens and carbons pair off with the oxygen in the air, forming carbon dioxide and water.[7] The amount of energy stored in a gallon of oil is equal to the amount in almost five kilograms of the best coal, or more than ten kilograms of wood or more than fifty well-fed human

slaves toiling the day away.[8] Oil contained so much energy that it could be used with abandon and still release much more energy than was required to get it out of the ground.

The men in Pennsylvania had a better idea than time-consuming hand-digging for this miraculous new liquid. They would drill an oil well, just as they had drilled wells for water and salt. First they'd find the oil seeps in creeks and hills and then they'd stab the earth nearby to get more out. In the famous story, in 1859 Edwin L. Drake, a former railroad conductor, drilled a hole on a farm where seeping oil was collected; at sixty-nine feet, the hole started, incredibly, to fill with dark fluid.

Explorers of all ilks criss-crossed the globe, hunting for the tell-tale leaks that might produce riches when tapped. On the other side of the ocean, Russians drilled the seeps whose eternal fires had so entranced the Persians. They shipped the oil from Baku in tankers—the first was called the *Zoroaster*—across the Caspian Sea. Around Baku, the smoke from the two hundred refineries that distilled the oil was so dense that the area was known as "Black Town." Russia's dirty oil started filling lamps across Asia, along with oil extracted from dripping rocks in Indonesia by Royal Dutch Shell. Entrepreneurs with dollar signs dancing in their eyes braved the hostile lands and people of Persia to drill along oil seeps there.[9]

By 1862, drilling near known oil seeps in Pennsylvania was bringing up 3 million barrels annually. They called it oil "production," a funny term given that they weren't "producing" anything, but taking something the earth had made countless years before humans had evolved. It took just thirty years for sixteen thousand farmers, entrepreneurs, and speculators to drain Pennsylvania's oil, by piercing the earth in as many places as they could and siphoning the oil out as fast as was then technically possible. When the oil wells abruptly ran dry, it was like a plague had fallen upon the nearby towns that had mushroomed around the wells. Having no idea how much oil there was underground or where it came from, they hadn't seen the end coming.

Unlike coal, which could essentially be thrown into a fire pit as soon as it came out of the ground, crude oil required energy-intensive processing in order to be truly useful. The oil that bubbled out of the ground was a messy mix of thousands of different kinds of hydrocarbons, the mushed remains of the cell walls of ancient algae, in various states of pressurized decay. There'd be some long chains of carbon, with seventy or more carbons linked together, as well as light gas, tiny little hydrocarbons with just four carbons linked together, and everything in between besides. The mix would vary from crude to crude, depending, in part, on how deeply buried the oil had been.

The different hydrocarbons in crude oil all burned at different temperatures, which was a problem when trying to harness the energy of their explosive combustion. The various fractions would have to be distilled into their various pure components, so that machines could be tailormade to specific types of hydrocarbons. To do it, refiners would essentially boil the crude.

As the crude gets hotter, different fractions reach their varying boiling points and turn into gas. At room temperature, the methane immediately evaporates. At more than 100 degrees Fahrenheit, the 8-carbon-chains—octane or gasoline—turn to gas and drift off. At around 500 degrees, the 16-carbon-chains, the diesel, evaporate. At over 1,000 degrees, even the tarry 80-carbon-chains, the coke, start to stew. In modern refineries, each constituent is lovingly captured, as its vapors rise in giant steel towers, cooling as they float higher and higher.[10]

But in the nineteenth century, there was only one fraction that was deemed useful. That fraction was kerosene, which was used to illuminate the nineteenth-century night, marking a considerable improvement over scarce sperm whale oil and the flammable turpentine people poured into their smoky lamps.[11] American refiners

distilled as much kerosene as they could; like Pliny, they considered gasoline worse than useless because it was so volatile.[12]

John D. Rockefeller, a stern, pious entrepreneur from New York, built his fortune on the market for kerosene. Rockefeller considered his task in almost spiritual terms, delivering light to a world of darkness. "Give the poor man his cheap light, gentlemen," he told his colleagues.[13] But in reality it was big business, and hugely lucrative. Rockefeller made it so with his merciless quest to expand his oil empire and dominate markets. He deployed secret front companies to underprice competitors, forcing them out of business. He controlled the means of transporting the precious fluid, extracting deep discounts from the railroads for train transport of his oil. The company countered the inevitable public outcry with clever deceits. "We should . . . parry every question with answers which while perfectly truthful are evasive of bottom facts," proclaimed one executive.[14]

Then, in the early hours of October 21, 1879, a sleepless Thomas Edison watched blearily as an electric current zapped through a glass globe in his New Jersey laboratory. Emitting a dim reddish glow, the world's first incandescent light bulb had been invented, and the electric power industry crackled to life.[15]

Society's desire for kerosene rapidly dissipated in the face of the new light. Yet Rockefeller and the other oil barons were swimming in oil. With the Pennsylvania fields wasted, the nascent American oil industry had moved on to Ohio and Indiana in the mid-1880s, where oil had also been dribbling out of the ground. A new market had to be found, and fast.[16]

The railroads forged in the heat of the Industrial Revolution, ferrying coal, steel, and people, coupled with horse-drawn carriages, defined transportation in the nineteenth century. Both required sizable inputs of energy to power their motion. Rail transport required tons of steel and sweat to build the trains and the rails, and then coal and humans

to power and maneuver them along the tracks. Animal-powered carriages required less energy input, just room and board for the creatures and materials to build the carriages, but were likewise less powerful and more limited in terms of range and utility. The ratio of the amount of energy put into the system versus the amount of energy released was, in other words, stubbornly constant.

In 1860, a small contraption that could radically increase the ratio of energy input to output had been invented: the bicycle. This compact simple machine could make human motion almost four times more powerful, catapulting an hour's exertion from a three-mile slog into a twelve-mile sojourn. It required little maintenance and its humble materials could repay their energy investment handily. Unlike the train, which relied on mountains of coal, and the carriages, exploiting animal metabolism, the bicycle was small-scale, human-powered, and efficient. (This is true even by today's standards. Modern trains require 210 kilocalories of energy to move a single person a mile forward. A bicycle can do it with just 20 kilocalories, the amount of fuel in a bite of banana.)[17]

The bicycle had quickly taken the world by storm. "Thousands of riders acquired a taste for speedy mechanical road transport," wrote car historians Jean-Pierre Bardou and Jean-Jacques Chanaron. It was a completely new way to move, because unlike the trains, which only traveled at certain times, and to and from certain places, bicycles could take their riders virtually anywhere and were "entirely under their own control."[18]

Perhaps it was inevitable, with trains steaming about and bicyclists sweating over their handlebars, that the two forms of transport would eventually merge. In 1886, four years after the invention of the light bulb had pulled the kerosene market out from under the wobbling oil barons, German engineer Karl Benz attached a motor to a tricycle. Inspired, two American bicycle mechanics designed their own motorized vehicle in 1893, a gasoline-burning automobile.

The new inventions didn't exactly overwhelm train-horse-and-bike society. Three years later, the bike mechanics hadn't sold even

a dozen of the autos.[19] The *New York Times* was not impressed. In the January 3, 1899, edition, they wrote:

> There is something uncanny about these newfangled vehicles. They are unutterably ugly and never a one of them has been provided with a good or even an endurable name. The French, who are usually orthodox in their etymology, if in nothing else, have evolved "automobile," which being half Greek and half Latin is so near indecent that we print it with hesitation.[20]

Besides being ugly and indecent, cars weren't very efficient at transporting people. Even today's cars require three times more energy than trains and thirty times more energy than bicycles to transport people a given distance.

But cars could be fast, and what's more, unlike the coal-powered trains, cars needed oil to speed along. Coal might compete with oil on some applications (after all, coal was much more abundant) but for this one, oil definitively trumped coal.[21] Coal was bulky and its energy was given off too slowly for machines that would need to be turned on and off quickly.

By 1900, Americans had built four thousand of the new gasoline vehicles, holding automobile races and other events to entice the public.[22] The fluid needed to propel the new machines continued to turn up in new and unsuspected regions. In 1901, an amazed public learned that essentially by chance, the premonition of a one-armed mechanic, oil had been struck under a salt dome in Texas, gushing out of the ground under its own pressure in a column twice as high as the derrick. Geologists and explorers renewed their hunt, this time looking for salt domes over which to position their drill-bits.[23]

With oil flowing so profusely, it wasn't long before American car production surpassed Europe's—the birthplace of the bicycle and the motorized trike—churning out forty-four thousand cars in 1907.[24] In 1909, automaker Henry Ford announced he would "build

a motor car for the great multitude,"[25] and it was only a year later, with Ford's affordable Model T's zipping off the assembly lines, that gasoline sales surpassed those of kerosene.

These new vehicles would go on to conquer the pedestrian, the bicyclist, and the railways themselves, paving over their rights-of-way with smooth asphalt for their immense engines, creating a thirsty new market for the oil industry in the process. Bicycle paths, like those linking Pasadena to Los Angeles, were abandoned half-built, as investors fled from the two-wheeled future they had earlier envisioned.[26]

The oil empire that Rockefeller founded, based on secrecy, consolidation, and market dominance, had found its *raison d'etre.* Although Rockefeller's Standard Oil monopoly was beheaded in 1909, fed on a fatty diet of gasoline sales, Standard's subsidiaries would slowly regenerate into the gigantic uber-companies from which they sprang.[27]

Britain had taken the plunge and converted its warships from coal to oil in 1912, even though the country itself had coal reserves but no known sources for oil.[28] It was like switching to an all-fruit diet while sailing the Arctic seas; they knew they'd have to take the stuff from someone else's country, and they already knew where: Iran. The British government had bought into a new British company, Anglo-Persian Oil, today known as the more familiar BP. The company had struck oil in Iran and the crown took it upon itself to protect BP's access to Persia's abundant hydrocarbons.[29]

Across the Atlantic, motorized warfare was off to an inauspicious start. In 1916, General John Pershing enlisted two thousand of the newfangled vehicles to travel two hundred miles into Mexico to hunt down revolutionary leader Pancho Villa. But so undeveloped were the roads and untested were the new machines that "at the end of the campaign," writes highway historian Lee Mertz, "all

two thousand vehicles lay strewn along the line of march in various states of breakdown."[30]

The following year's military exploits proved no better for the reputation of the automobile. The Americans were preparing to send 2 million soldiers, with their horses and fodder, across the ocean to join in the First World War. But how to get them there? All of those men and animals, spread out over the continent, would have to be amassed on the U.S. east coast in order to board ships across the Atlantic to Europe. That appeared impossible. Desperate, the military decided to try trucks again, despite the troubles during the campaign against Pancho Villa.

The nascent auto industry produced thousands of trucks to carry the soldiers and their equipment to ports on the east coast. Once again, the decrepit roads stymied the effort. Where they existed, the roads were impassable. The dirt paths were swamped in mud and obscured by piles of snow. The new trucks, those pinnacles of oil-industry and car-making technology, couldn't get through. The trucks ended up being loaded onto trains, which carried them to the next section of passable road, while crews worked around the clock to clear snowdrifts.[31]

Still, the Allied forces didn't lose faith in the internal combustion engine and its magic fuel, a faith that turned out to be worth the trouble. Britain and the United States unleashed the fury of their agile, petroleum-burning machines—about 163,000 oil-burning vehicles and 70,000 airplanes—vanquishing Germany's bulky coal-fired ones. Black gold was crowned king. Ten days after Germany surrendered, in November 1918, British statesman Lord George Nathaniel Curzon declared the Allied forces' triumph as petroleum's. "The Allied cause had floated to victory upon a wave of oil," he said.[32]

Back at home, demand for light clear gasoline continued to grow. In 1930, essentially by luck, oil explorers discovered the bountiful

oilfields of East Texas. Texan oil flowed from a geological formation, at the time unexpected to hold crude: an "angular unconformity." As jubilant oil hunters fanned out searching for more, General Motors, Standard Oil and Firestone banded together to take over the nation's streetcar companies. Between the world wars, only about one in ten Americans owned a car, as most urban residents traveled by electric streetcar, which whisked commuters along their steel tracks leaving just the bumpy margins of the roads for automobiles.[33] As Texas's oil spilled forth, the companies boldly attempted to force consumers to opt for gasoline-burning cars instead, curtailing electric trolley services and replacing them with unpopular diesel-burning buses.[34]

Meanwhile, chemists were beginning to unlock the mysteries of a small but popular set of natural and semisynthetic materials called "plastics," from the Greek word "plastikos," meaning "able to be molded."[35] These elastic substances derived from all kinds of unlikely sources—amber, horn, wax, bitumen, shellac (from the secretion of the lac beetle), and gutta percha—and their unusual properties made them uniquely useful. Gutta percha, a dark-brown material from the Malaysian palaquium tree, was used for sheathing the first submarine telegraph cable. Shiny hard buttons could be made from casein, a paste of milk curds mixed with formaldehyde. Flexible but firm tires could be made from rubber trees, grown in plantations in Southeast Asia, and mixed with sulfur to form "vulcanized rubber." Celluloid, cellulose from cotton mixed with vegetable oil into a dough that could be molded into shapes or pressed into thin sheets, was used to capture early photographs and to form into billiard balls, replacing earlier ones made of elephant tusk ivory.[36]

At first, chemists thought these jelly-like compounds were actually a multitude of small molecules somehow held together. But then the truth came out: these elastic materials consisted of single molecules of unheard-of lengths. Some could have hundreds of thousands of atoms strung together in long flexible chains.[37]

With this insight, chemists set about building similar molecules, cracking, reforming, linking, and de-linking carbon chains, much

as refiners did. The best compounds they came up with indeed were extremely malleable. Some could even be melted, molded, hardened into shape, and then melted and molded again. They could be stretched out in thin sheer sheets, cut into slivery threads and woven into fabrics, or shaped into poles and platforms to build furniture. The new synthetic plastics didn't *have* to be made out of oil—coal, alcohol, or natural gas could all be changed into the necessary building blocks—but with the gush of byproducts from refineries, oil was the cheapest and easiest option.[38]

In 1940, *Popular Mechanics* magazine predicted that "the American of tomorrow" would be "clothed in plastics from head to foot . . . will live in a plastics house, drive a plastics auto and fly in a plastics airplane."[39] The Second World War would help make it so.

By 1941, Japan had taken control of the rubber plantations of Southeast Asia, cutting off the supply of natural rubber to the United States. For American soldiers and pilots fighting in Europe, this meant that a flat tire had become a death sentence. The U.S. government pumped over $3 billion into the fledgling petrochemicals industry, demanding a ramped-up supply of synthetic rubber, along with whatever other goodies the industry could devise. With a river of byproducts streaming out of the oil refineries—themselves working in overdrive to provide fuels for the war effort—the petrochemists outfitted soldiers not just with synthetic rubber tires, but with nylon parachutes, synthetic rubber life rafts, plexiglas airplane windows, and plastic raincoats. Other crude byproducts, such as naphtha and methane, were blasted into nitrogen ammonia for explosives.[40]

Out on the battlefield, oil's essential role in powering the machines of war was undisputed. Military leaders took aim at the veins and capillaries of the enemy's oil supply. Allied submarines targeted Japanese oil tankers, crippling the oil lifeline to that oil-poor country. Allied torpedoes sent over 2 million tons worth of Japanese warships and oil tankers to the bottom of the South Pacific. The sunken oil might threaten delicate coral reefs and fishing grounds many decades later, but it wouldn't power the Japanese war machine.[41] "Toward the end," commented one Japanese captain, "we were fairly certain a tanker would be sunk shortly after departing from port." By the first quarter of 1945, not a single drop of imported oil reached Japanese shores, and the Japanese started building their naval ships to burn labor-intensive coal instead.[42]

When the war was over, the U.S. government sold its chemicals plants back to the oil and petrochemicals industry for a fraction of their cost. Exxon nabbed a $2 million petrochemicals plant for a mere $325,000. Monsanto acquired one that cost over $19 million for $10 million. DuPont got a $38 million facility for $13 million. Off to a running start, refineries and petrochemicals companies "were now ready to supply copious amounts of petrochemicals," writes historian Peter H. Spitz, serving "pent-up consumer demand for products that could be made from these materials."[43]

The United States, with seemingly plentiful oil in Texas, Oklahoma, California, and elsewhere, had little need, at first, to plunder foreign lands for its black gold. But many fields were rapidly exhausted as the Second World War exerted its heavy demands on the industry. The technology that would allow the industry to sniff out deeper, more hidden oil reservoirs had yet to be developed. By the end of 1943, Secretary of the Interior Harold Ickes was sure the United States stood on the brink of an oil famine. "If there should be a World War III it would have to be fought with someone else's petroleum, because the United States wouldn't have it," he wrote, warning that "America's crown, symbolizing supremacy as the oil empire of the world, is sliding down over one eye."

Ickes insisted that "we should have available oil in different parts of the world," and "the time to get going is now." No matter how generous domestic oil reserves may have been, controlling the giant foreign oilfields that other countries would have to rely on could only elevate the United States' strategic power. After all, with more

and more sectors of the economy reliant on oil, military prowess dependent on its riches, and popular support contingent upon a growing economy, securing access to oil was crucial to maintaining power. In 1944, then-President Roosevelt staked America's claim to the Middle East's oil. Arrangements were duly made with the British. "Roosevelt showed the [British] ambassador a rough sketch he had made of the Middle East. Persian oil, he told the ambassador, is yours. We share the oil of Iraq and Kuwait. As for Saudi Arabian oil, it's ours," as historian Daniel Yergin described the exchange.[44]

Elites in Western countries had been helping themselves to slaves, silk, spices, and other goods from less powerful regions of the world for centuries, from the Niger Delta to the Indian subcontinent. Oil would be no different.

In 1946, a Justice Department investigation found General Motors, Standard, Firestone and other oil, auto, and rubber companies guilty of attempting to control public transportation. But the miniscule fines levied against the auto and oil industries were nothing compared to the grand upheaval they had effected. By the 1950s, the electric trolley system of public transportation had been effectively dismantled. The abandoned trolleys rusted in Los Angeles' vacant lots, where homeless scavengers turned them into impromptu shelters. Commuters would have to either take the bus or buy a car.[45]

While the oil industry was swept up with increased demand, basking in its ability to create ever more products and dominate a wide variety of markets, the coal industry was mired in conflict. Exploited coal miners had been rising up in anguish. Between 1929 and 1954, the U.S. coal mining industry lost 5 million worker-days to strikes every single year. And for every interruption in the coal supply, fed-up factory managers would invest in the switch to reliable oil.[46]

The black environs of London, the coal capital of the world, had become murderous. Although the moths could perhaps adapt—the

peppered moth famously turned black so it could blend in with London's dark, lichen-stripped trees[47]—the people, increasingly, could not. On December 4, 1952, the wind sweeping through London died down and a warm humid layer of air descended on the city. The 1,000 tons of smoke particles, 2,000 tons of carbon dioxide, 140 tons of hydrochloric acid, and 370 tons of sulfur dioxide that Londoners' coal fires had pumped into the air that day were trapped over the city. Five still, windless days followed, and the stagnant 30-kilometer cloud of smog smothering the city turned amber, then green, then brown, and finally black. The sulfur dioxide reacted with sooty water droplets in the air to form a soup as acidic as battery acid, which scraped Londoners' throats, unleashing a torrent of mucous and inflammation. Many didn't make it to the overflowing hospitals, but collapsed in the street, blinded by the black fog. Fifty corpses littered a single city park, and the undertakers started to run out of caskets. When the smog finally lifted a week later, over 4,000 had perished.[48]

Before the war, coal accounted for about half of U.S. energy use; by 1955, it was responsible for less than a third. By 1956, even the city of London banned coal fires.[49]

It took less than a century for oil to eclipse coal, following the arc of oil-rich America's eclipse of coal-rich Britain. It wasn't just that oil was so powerful and versatile it could be used for everything from lighting lamps and powering vehicles to making clothes. It was also that the riches that could be earned by its extraction triggered intense competition between profit-seeking companies. The more precious oil became, because of geological depletion or because access to its reserves was cut off, the farther the industry's operations would reach, and the hungrier these big companies would be for sales to sustain themselves. And so, oil companies penetrated one market after another, in some cases endeavoring to manufacture

new markets, helped all along by the nations whom their black gold showered with war-making prowess.

Coal continued to be burned, of course: over a billion tons of it in 2001 America alone, mostly for electricity. But it would no longer be smoking away in front of people's faces. Instead of hundreds of thousands of little fires, the industry would burn a handful of gigantic bonfires, transforming coal's dirty energy into likable electrons before piping it into people's homes. During the coal era, the typical American family would shovel about three hundred pounds of coal into their stoves every week. Now the stuff they would pump into their machines would be fluid.[50]

CHAPTER TWO

Exile from Tethys

After the Second World War, with the spoils of war divvied up among the victors, the countries of the West started a happy expansion. Oil-engorged and stable, the economies of Europe and the United States boomed during the 1950s and 1960s, and fed on the petrofuels, technologies, and products forged during the war.

Since the embarrassment of the First World War, when America's trucks had to be ferried by trains because of the nation's pathetically rutted roads, the oil industry had partnered with automakers to lobby for a network of smooth black asphalt criss-crossing the country on which their war-winning cars could ramble. In 1956, while the last coal fire was stubbed out in London, their lobbying finally paid off. The U.S. Congress earmarked over $26 billion for the National Interstate and Defense Highway System Act, setting off a fit of road-building that would profoundly alter the country.

American families and industries used the smooth roads and their new automobiles to drive themselves away from the congested cities. Between 1950 and 1990, suburban sprawl had become so intense that some areas were gobbling up land four times faster than their populations grew.[1] The new suburban nation survived by virtue of a web of asphalt and a river of oil, allowing them to access food, fuel, and labor from the distant homes in which they had cocooned themselves.

Like the horse before it, the car became a kind of much-needed, beloved pet. Gallons of ink were spilled describing the love affair between Americans and their cars, a romance the auto industry spent billions advertising. From 1957's publication of Jack Kerouac's classic novel about hitchhiking, *On the Road,* to drive-in movies and

hot-rodding, Americans of all stripes embraced car culture. In 1955, more than 50 million cars were registered in the United States; twenty years later, over 100 million were on the books.[2]

By the 1950s, the synthesis of ammonia used for nitrogen fertilizers by Standard Oil and Shell, among others, was growing exponentially. German chemist Fritz Haber had discovered how to use petroleum's power to make ammonia back in 1909, effectively unlocking nature's restraint on plant growth. Before Haber, plants relied on about one hundred genera of bacteria to capture the nitrogen essential for their development. Employing methane to create extreme heat (up to 600 degrees Celsius) and intense pressure (equivalent to being submerged under about six thousand feet of water), Haber transformed nitrogen from the air into NH_3, ammonia, which could be used to make nitrogen fertilizers. Petroleum had allowed Haber to capture the Holy Grail of inorganic chemistry, something that had eluded chemists for more than a hundred years.[3]

The result out in the fields was remarkable. Agricultural yields doubled between 1947 and 1979, and the global population of humans skyrocketed. Before nitrogen fertilizers, there were fewer than 2 billion humans on the planet. By 1979, there were well over 4 billion. Without nitrogen fertilizer, geographer Vaclav Smil calculates, about two-fifths of today's 6 billion souls would not be alive. "Never before have so many people—be it in absolute or in relative terms—enjoyed such an abundant supply of food," Smil writes.[4]

As the fertilized crops grew copiously, so did the farm operations that harvested them. Big mechanized farms were hooked on oil not only for the fertilizers and pesticides that produced their super-sized crops but also for the machines that would harvest them and the oil-fired transport that would speed the crops to distant markets.

Meanwhile, plastic was becoming the most used material in the world, found in everything from space ships, garbage bags, children's

toys, prosthetic limbs, and X-ray equipment to nylon stockings, acrylic sweaters, Teflon pots and pans, vinyl floors, Velcro closures, life jackets, glossy paper, and printing ink.[5] The natural plastics, those quaint wooden, shell, and cotton objects, were demoted to mere artifacts, the last vestige of celluloid's heyday hanging on in the lowly Ping-Pong ball, quite possibly the only object whose market the synthetic plastics industry still hasn't been able to overwhelm.[6]

Plastic penetrated every sector of the economy, touting itself as the very stuff of life; the word itself summoned up the future, as Dustin Hoffman's character in the 1967 film *The Graduate* was famously told. It was true, to an extent. What else could possibly be used for airplane windows or football helmets or surgical gloves?

In the heart of the oil business, tucked away in Shell's petroleum research lab in Houston, a crotchety geologist, calculator in hand, dropped a bomb on the party. In 1956, geophysicist M. King Hubbert announced that, according to his calculations, the seemingly bountiful flow of oil from Texas and Oklahoma, along with the rest of the country's oil territories, would reach its zenith by the early 1970s, after which it would start to decline. No matter where they looked for more oil, no matter how heroically they pumped it out, whatever oil was under U.S. soil had already been found and half or so would be gone within fifteen years, Hubbert proclaimed. The bosses were not happy, recalls Kenneth Deffeyes, who shared a lab with the "curmudgeonly" Hubbert. "Shell hated it!" said Deffeyes. "Right down to fifteen minutes before he gave his talk, the head office of Shell was on the phone saying, 'Don't do it, don't do it!'" It didn't matter at the time, anyway. With the oil party in full swing, nobody believed Hubbert's gloomy prognostications.[7]

While increasingly comfortable middle classes enjoyed oil's bounty in the West, the people at the other end of the bulging pipelines and well-trammeled tanker lanes remained mired in dispossession and conflict. When Britain pulled out of colonial Palestine in 1948, it had handed power over much of the country to the minority Jewish population, increasing their share of the country's territory from 6 percent to 56 percent. The neighboring Arab states never agreed to the UN-sanctioned deal, and fighting commenced almost immediately.[8]

The Western oil companies continued to exploit Middle Eastern oil assets the way any private, for-profit company would: to maximize profit. The situation in Iran typified the situation. BP and the British government both raked in more money from the extraction of Iran's oil than the Iranian government. BP's margin on Iranian oil was so good it was able to earn 250 million pounds in profit between 1945 and 1950. The Iranian government earned just a fraction of that, 90 million pounds, from royalties.[9]

Amidst heightened conflict at home and seemingly insatiable Western thirst for crude, it started to dawn on many in the oil-producing countries that the oil that coursed under their feet might properly be considered their national heritage, which could be developed for the good of society and its future generations instead of a foreign company's bottom line. In 1956, Egyptian president Gamal Abdel Nasser, fed up with "the great capitalist monopolies in the advanced developed countries" that "rel[ied] on the exploitation of the sources of wealth in the colonies,"[10] took over the hundred-mile-long Suez canal that coursed through the Egyptian desert, through which two-thirds of Europe's oil was ferried on tankers.[11] Nasser promised more to come. "I see the Iraqi people in shackles, facing fire and steel," he thundered. "We shall all defend our freedom and Arabism . . . and work until the Arab nation extends from the Atlantic Ocean to the Arab Gulf."[12]

Barred from the narrow Suez, which slashed the journey from the Persian Gulf to Europe almost by half, wary oil companies turned

instead to the longer journey that avoided the canal. They wouldn't be able to afford as many trips. The tankers carrying the oil would have to be huge.[13] (In time, the tankers would grow so large that many wouldn't be able to pass through the Suez's constricted passages at all, even if they had wanted to.)

From there, things went from bad to worse. In 1960, the death knell for the early oil industry tolled. The Organization of Petroleum Exporting Countries (OPEC) was formed, a cartel that today includes Algeria, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates, and Venezuela.[14] One by one, OPEC countries kicked Western companies out, taking over their assets and declaring their country's oil the sole province of state-run companies, to be developed at a rate dictated by the logic of governance—or at least the self-interest of ruling elites—not Western profit-making.

The Western oilmen abandoned their suburbs in the Arabian sands and went home, angrily. The abundant oilfields holding up to two-thirds of the world's oil percolated underneath these countries.[15] Oil historian Daniel Yergin gives eloquent voice to their rage:

> They had created value where there was none. They needed to be compensated for the risks they had taken—and the dry holes they had drilled. They believed that they were being put upon by greedy, rapacious, and unreliable local powers-that-be. They did not think that they were 'exploiting'; their plaintive cry was, "We wuz robbed."[16]

Thus shorn of easy access to more than half of the world's oil and the great majority of it that lies in easy-to-find and cheap-to-produce areas (Western companies had already been barred from touching Baku's 300 billion barrels and the rest of the oil in the Soviet Union in 1917, along with the 13 billion barrels in Mexico in 1938), the industry turned to politically safer regions, with progressively

smaller reserves and increasingly formidable environments, relying on technology to get them there. Meanwhile, the hungry engines of the global industrial machine were, by 1960, slurping up over 21 million barrels every day.[17]

The quest to find oil outside the oil-rich countries, where the stuff was literally leaking out all over the place, was Herculean. Crude methods, born of both greed and luck, had already exposed the majority of the world's oil. By 1950, all of the structural traps in the United States that were visible from the surface had been drilled.[18] By the mid-1960s, the majority of the world's giant oilfields had already been discovered, mostly on the lands that the Tethys had washed over, in Iran, Iraq, Kuwait, and Saudi Arabia, along with Venezuela.[19]

Oil explorers would have to pinpoint layers of source rocks that could be as thin as thirty feet thick, buried under tens of thousands of feet of rock.[20] If the migrating oil hadn't found its way to the top where someone could see it, or if the geological formation that had trapped the oil wasn't visible at or near the surface, how would the companies even start to look?

A lot has to happen before a company can position its drill to actually figure out what is under the ground. Geologists theorize on whether the geology looks "prospective." If it does, then access has to be secured. Finally the rigs move in, and the companies lay out anywhere between $5 and $30 million to confirm whether what they are looking for is there by drilling an exploratory well, looking for oil, gas, or any tell-tale clues in the rocks that something oily might be there. A lot of times they are wrong.

Once oil companies knew they were in "oil country"—places where they had determined that oil burbled somewhere underfoot—they only had to sniff out the places where the stuff was trapped. Still, the success of exploration wells was bad even then.

Exploration geologists marked a tiny "X" on maps covering huge

chunks of the earth's surface. The holes they'd drill would be just eight inches in diameter. "It's easy to miss the target, and a single unsuccessful wildcat (dry hole) often condemns the entire prospect," said one petroleum engineer. With millions of dollars at stake, "Precision is essential," he went on, admitting that "it isn't really possible because exploration geology operates with a minimum of information."[21] The key to success, exploration geologists said, was to use all the information you could get together and then proceed "in the presence of uncertainties."[22]

As much as geologists knew about oil and its movements, and the huge amounts of money involved when they were wrong about their guesses, nine out of ten exploration wells drilled in the United States were dry holes. Just one in a hundred exploration wells discovered a usable oilfield.[23] When, in 1975, two University of California geologists analyzed the three hundred thousand exploratory holes that had been bored in the continental United States, they concluded that more oil would have been found faster had the holes been drilled completely at random.[24]

Military technology, harnessed to hunt the enemy and underwritten by the public, was transferred to the private hunt for oil, which many described in openly warriorlike terms. The mapping of the ocean floor for submarines, aerial surveys for picking out bomb targets, and seismographs used to pinpoint enemy artillery: all of these military technologies developed to wage war were put to service in the hunt for oil.

The seismograph proved to be the "most powerful new weapon of all," as one historian put it.[25] Translating the echoes of seismic waves pumped into the ground could reveal the deformations where they lay below unseen, just as a bat's clicking could find its mosquito. The reverberations from explosions of dynamite, a vibrating steel plate under a truck, or underwater bursts of air would be recorded by tiny microphones stuck into the ground or dragged behind boats.[26] Seismic information was recorded from top to bottom and side to side, yielding a two-dimensional slice of data about the rock.

By the 1950s, seismologists had started to record their echoes on digital magnetic tape, allowing computers to analyze the mountains of data.[27] As computers improved, so did the speed and sophistication of the data analysis.

From each oil strike, explorers would fan out incrementally, slowly leading them to slip off the side of dry land and wade into the shallow water. By around 1950, companies had drifted off the spent oilfields of Texas and California into the shallow waters off the coasts. As seismic surveys improved, they found that some oil was trapped under the water, untapped. The lure of a big find pulled them in deeper as effectively as an undertow.[28]

Geologists had suspected there might be oil bubbling from the thick marine sediments under the North Slope of Alaska since the 1920s, but the harsh Alaskan environment had kept them away. At the North Slope, an area larger than the whole of Minnesota, winter temperatures could plummet to 40 below. Add to that two months of continuous darkness and ground permanently frozen down to two thousand feet.[29]

By 1967, oil companies had just about given up on finding any oil in Alaska. There was one last exploratory well scheduled to be drilled, at Prudhoe Bay on the northern coast, where the Sagavanirktok River splashed into the Arctic Ocean. They almost didn't bother, but the rig was already there and only had to be moved sixty miles. "It was more a decision not to cancel a well already scheduled than to go ahead," explained the oil exec who ordered the well. The conflict in the Middle East had intensified, as Israel attacked and conquered the Arab-populated lands of the Sinai Peninsula, Gaza Strip, West Bank, and Golan Heights in June 1967. Any dribble of domestic oil, no matter how chilly, would surely be greeted with approval from American officials.

The day after Christmas that year, the drillers at Prudhoe Bay made an incredible discovery: over 10 billion barrels of recoverable oil situated thousands of miles away from the bloody conflict in the Middle East. It may have been just a fraction of the amount of oil sitting under Saudi Arabia, but Prudhoe Bay was the largest oilfield ever found in North America.

While oil companies set to work developing the harsh new oilfields, analysts debated over how to supply the oil to thirsty American engines in the lower forty-eight. Nuclear physicists suggested that nuclear-powered submarines might carry Prudhoe's crude. Others advised a fleet of jumbo jet oil tankers. A pipeline, in the end, seemed the most sensible idea. But heartbroken locals and environmentalists, worried about the fate of their beloved Alaskan wilderness, fought the proposal bitterly, winning a court injunction against its construction in 1970.[30]

Oil explorers' determination against the elements paid off across the pond in Britain as well. In the days when Middle Eastern oil was available for the taking, nobody in the oil industry was interested in the North Sea, bound by the east coast of Great Britain, Norway, and the Netherlands. That shallow sea was so turbulent that one of its storms had vanquished an entire invading armada back in 1588.[31] The equipment needed to even think about exploring or drilling in such a forbidding place was hardly available at the time; a few feet of calm shallow waters might be all right but somewhere like the North Sea was inconceivably difficult. Plus, it wasn't clear who owned the rights to explore or drill in it.

Still, geological clues as to the Sea's crude potential tantalized. In the early 1960s, a huge gas field had been unearthed in the northern Netherlands, and geologists found that the same rocks that spurted that gas lay on the other side of the North Sea in eastern England.

Those same hydrocarbon-rich rocks might extend underneath the North Sea as well.[32]

If so, it would be a tremendous boon to Britain, by then a fallen colonial power. Hopeful government officials resolved the ownership issues. Seismic surveys followed, showing plenty of "bright spots" where the pore spaces in the rock had trapped gas. The race was on.[33] In the early 1970s, BP and Shell pinpointed two of the North Sea's biggest oilfields, the Forties and the Brent fields. Eventually, oil companies would find over 16 billion barrels of oil under the North Sea.[34]

As in Alaska, draining the North Sea oilfields would be expensive and physically challenging, but oil companies could rest assured that their costly investments would be safe. Unlike in Mexico, Iran, or Saudi Arabia, the British and U.S. governments could be relied upon to drape a protective wing over their activities.

In 1971, while the industry readied their conquest of Alaska and the North Sea, Hubbert's unheeded prediction quietly came true. The government agency that regulated the amount of oil pumped out of U.S. wells announced that the oilmen could pump out as much as they liked. "The Texas Railroad Commission announced a 100 percent allowable for next month," read the obscure announcement in the *San Francisco Chronicle*, Hubbert's colleague Kenneth Deffeyes recalls. "I went home and said, 'Old Hubbert was right.'"[35] From then on, the taps in the lower forty-eight states would be fully on; if the flow of oil they provided was insufficient, Americans would have to look elsewhere for more. Oil production from the United States, save for Alaska, would steadily decline ever after.

The news may not have been heard very loudly outside the industry, but within it, "The world split," says Deffeyes.[36] "There were Hubbertians and non-Hubbertians. The non-Hubbertians were larger in number and tended to be economists, managers, and a lot

of geologists," who insisted that the boys were crying wolf. They argued, variously, that higher prices would provoke more drilling and thus render more oil; technology would improve so that more oil could be pumped out of already spent oilfields; that previously inaccessible hunting grounds like Alaska and the North Sea would pour forth riches; that Saudi Arabia still sat on a goldmine and could easily make up any shortfall. But many insiders took Hubbert's predictions to heart, and "literally shaped their careers around it," Deffeyes says.[37] They didn't trumpet the news to the masses, but anyone watching might have noticed their minor exodus from the U.S. oil business, as shaken engineers, geologists, and others fled for more secure industries, some migrating into nukes, others, like Deffeyes, into the ivory tower.

CHAPTER THREE

Into the Cold

By 1973, the earth's crust was bleeding more than 55 million barrels of oil every day, over half of it from the Middle East.[1] With each barrel swallowed by the industrial world's roaring machines, there wasn't a drop to spare.

Then, in October of that year, Egypt and Syria attacked Israel, attempting to recapture territories lost in 1967.[2] The United States promptly arranged for aid to be sent to Israel.

For the ministers in a then-obscure cartel called OPEC, this was just too much. They decided to take a stand. What they did would make OPEC "a household word, not just an obscure acronym," noted the *National Petroleum News*, turning Western attention to the distant lands they unknowingly relied on "for the first time."[3] Several OPEC ministers voted to cauterize the arteries pumping life-blood to Israel's allies, embargoing shipments of oil to the United States and the Netherlands.

Over the next six months, the price of the now much scarcer oil skyrocketed from $3 to almost $12 a barrel. The effect on industrial oil-gorging economies was tremendous and long-lasting. Almost every product by then came with an embedded oil cost.[4] Between 1970 and 1980, consumer prices doubled. Unemployment rose. Inflation set in.[5]

Then-President Nixon considered forcibly seizing Middle Eastern oilfields, but American soldiers were already stuck in a costly unpopular war in Southeast Asia.[6] What else could the United States do? Its own once-prodigious oilfields were in decline, North Sea and Alaskan oil had yet to come into full production, and the country relied on imported oil for almost a third of its oil.[7] They'd have to

settle for a slow buildup of forces in the region: maybe they'd be better prepared next time.[8]

In the meantime, as prices kept rising, the government reluctantly did the obvious: institute measures to curb energy consumption. Nixon instructed homeowners to turn their thermostats down and companies to shorten working hours. Gas stations were to ration each driver to just ten gallons each. No gasoline would be sold on Sundays. For the first time, vehicles would have to meet some minimum efficiency requirements. Later, President Carter would urge energy conservation, appearing on national television wearing woolly sweaters in the chilly White House. He pressured companies to reverse their historic switch from coal to oil and gas—and to go back to coal. In 1978, he instituted the "gas guzzler" tax, a penalty leveled at those who bought inefficient cars.[9]

"Governments, corporations, and individuals were entirely unprepared for this turn of events," writes historian David Hackett Fischer. "Many American families found their budgets strained beyond the breaking point."[10] A new government agency was formed to study how energy was used in the economy—it would come to be called the Department of Energy.[11] A new way of thinking about energy, power, and society sprang up in the book-lined thinktanks and universities, with groundbreaking works from political philosopher Ivan Illich, biophysicist Donella Meadows, economist Herman Daly, and others. But none of it made much sense to insular, oil-coddled Americans. Commented one finance writer, "To many Americans it was impossible to understand how their standard of living was now being held hostage to obscure border clashes in strange parts of the world."[12] Broke and uncomprehending, they waited impatiently in the endless lines at the gas stations. Disappointment turned to pessimism, and a widespread cynicism set in.[13]

President Gerald Ford instituted a stockpile of oil, to be used in a future emergency: the Strategic Petroleum Reserve. Ultimately, several billion barrels of oil would be squirreled away in Louisiana's salt domes for safekeeping should capricious oil suppliers play dirty again. The industrialized countries that depended on OPEC oil formed their own alliance to counter the cartel, the International Energy Agency.

The second "oil shock" arrived in 1979 when Islamic fundamentalists overthrew the Shah of Iran. America's shaking hand curled into a fist. Carter announced what came to be known as the "Carter Doctrine." From then on, the policy of the United States would be to smother any hostile act that might curb the flow of the Gulf's oil using "any means necessary."[14]

However dispiriting and difficult the 1970s oil shocks were to Americans, they were much worse on the countries of the developing world. Poorer countries couldn't simply cut back on Sunday driving in order to weather a quadrupling of oil prices. Their newly industrializing factories needed the oil to function. The oil-intensive mode of growing food prevalent in the West had taken hold, and those who eked out a life growing their own food on small plots had seen their lands bulldozed by the oil-fired machines, sprayed with oil-derived fertilizers and pesticides, and their monoculture crops carted off on oil-burning trucks and planes. Amidst the plenty that petroagriculture made possible, one out of every seven human beings still went hungry, yet at least in the short term, industrial farms would demand their crude to avert potentially even greater catastrophe.[15] Many Third World governments borrowed billions of dollars from commercial banks and institutions to pay for the expensive oil imports.[16]

A crushing debt grew. In 1970, the developing economies of the Third World had a manageable external debt, approximately $100 million. By 1988, the Third World's external debt had grown to a staggering $1.3 trillion. Just paying the interest on these loans constituted a massive transfer of wealth from the countries of the South to the bankers of the North.[17]

Meanwhile, the oil industry was enjoying golden years. Flush with

cash from the pricey oil that was dragging so many economies down, oil companies invested in developing their perilous but politically safe treasure chests in Alaska and the North Sea.

In hot pursuit of "energy independence," the nation's new battle cry, Congress had decreed that the trans-Alaskan pipeline be given the go-ahead.[18] The old gangs from Saudi Arabia were resurrected. A $50 billion matrix of roads, rigs, and machines rapidly colonized the windswept, icy, coastal plains, ferrying in drawling cowboy-booted oilmen from the south. "The whiteout blend[ed] sky and earth in a deafening whiteness," remembers one oil consultant, fondly. "And here, where the opposite extremes of earth are found, here you find the commonality of the drilling rig and its crew, the buddies of those in Arabia. Some have been there themselves. I hear[d] the drawl, and I [saw] the cowboy boots and the tobacco spit again."[19]

The clouds of dust following the zooming trucks and tankers sent the wildlife running, hunters finally penetrating the tundra on the new roads made for oil. The oil empire exhaled almost a hundred thousand tons of pollutants into the cold air every year and leaked over a million barrels of contaminated wastes every day. The native Alaskans watched as strange new sores and lesions befell their moose and caribou, their children started coughing more, and their seals' skins thinned.[20] Yet the industry and the governments that supported it were determined to continue plumbing the most forbidding seas and braving the most extreme climates in pursuit of crude anywhere in the world—except for in OPEC countries.

The triangular island of Newfoundland lies off the eastern edge of Canada in the frigid North Atlantic. It is a snow-covered jag of rock, its poor soils supporting stark pine forests and reindeer-moss covered plateaus. The people who live there, "Newfies," are the poorest and least-employed people in Canada.

One hundred and eighty miles off Newfoundland's southeastern

coast, a series of banks rise off the continental shelf. Cold currents from the Labrador Sea wash over the banks, carrying stately icebergs, broken off the Greenland ice sheet. Meanwhile warm waters pushed by the Gulf Stream rush in from the south. As the frigid waters meet the warm over the shallow banks, clouds of fog are belched into the air, and the waters below start to churn.

This patch of ocean has long been known as "iceberg alley" to the Coast Guard. The lethal combination of shallow water, fog, and icebergs over the banks menaced the busy shipping lanes linking North America to Europe. Some of these ice pillars could be as heavy as 5 million tons, soaring to three hundred feet above the water.[21]

The waters are rich in oxygen and nutrients, providing a perfect medium for plankton, the precursor to a lush food chain. For more than four hundred years, fishermen and women from all over the world braved the seventy-mile-per-hour winds and hundred-foot swells of the largest of the banks, the 350-mile-long Grand Banks, for what was once one of the richest fisheries in the world.[22]

In 1979, Mobil, after drilling and abandoning fifty dry holes, struck oil off the Grand Banks in a field dubbed "Hibernia." The news met with great excitement among political elites, oil execs, and the long-suffering Newfies. Hibernia became the "indisputable darling of Wall Street investors," with commentators guessing the Grand Banks could hold up to 10 billion barrels of oil. This was "big-league stuff," as one analyst gushed.[23]

But how to get it out? In order to drill exploratory wells off the forbidding Grand Banks, oil companies would need a new and improved kind of vessel, one able to withstand the blow of gigantic icebergs. They'd need something much better than the Titanic, which an iceberg had punctured near the banks in 1912, and it wouldn't come cheap. Drilling a single well under the ocean could cost four times more than even the most expensive wells drilled on land.[24]

The truth was that oil companies were extremely cautious about new methods. Mistakes were costly and nobody wanted to ruin a perfectly decent well with some untested gadget, no matter how

efficient or groundbreaking it might be. "Making a huge up-front investment in a technology that might not be commercial for ten years may be a necessity, but it's not a pretty addition to the balance sheet," commented one analyst.[25] By the turn of the millennium, many were still lionizing the breakthroughs that made Halliburton and Schlumberger legendary names in the business, innovations pioneered in the 1920s.[26] As a petroleum engineer put it, the industry was "totally oblivious to other technologies that were not stamped with a big H or a big S."[27]

Oil companies approached the problem of taming the banks' icy tempest the same way they approached others: enlarge. In 1981, Mobil spent almost half a million dollars a day to send a towering rig to drill exploratory wells on the stormy banks. At fifteen thousand tons, the rig, called the Ocean Ranger, was the world's biggest. "The massiveness kind of terrifies you at first," the Ranger's captain admitted.[28] The platform was twice the size of a football field. As one reporter who ventured onboard put it:

> [The Ocean Ranger was] as square and solid as the Parthenon, which, with her eight massive supporting columns, she somewhat resembled. Towering thirty-seven stories from keel to derrick top, moored by twelve anchors with cables each a mile long, the Ranger seemed a temple of stability. Veteran ship captains were amazed to find that she hardly rocked at all, often less than half a degree. But the oil men who ran the Ocean Ranger just propped up their cowboy boots and smiled. Well, Oklahoma didn't move around under your feet, either.[29]

The rig was considered unsinkable.

The ship's able captain boasted forty years of nautical experience, but unlike most other vessels afloat in the sea, the captain didn't have ultimate authority over the Ocean Ranger. The person in charge of the ship wasn't a mariner, but an oilman. Even while drilling miles

away from solid ground, "land-bound, oil-field tradition prevailed," as the *Washington Post* described. Once anchored for drilling, the captain wasn't even required to be on board the Ranger.

The captain watched, dismayed, as routine seagoing protocols fell by the wayside. Reports that the Ranger had discharged a hundred gallons of diesel fuel went unreported to the Coast Guard. The drilling workers wouldn't show up for their lifeboat-skills training. No pumps or alarms stood at the ready should the ship take on water. The captain, Karl Nehring, sometimes complained to the chief oilman about the various safety breaches. "Who's in charge, Karl?" he'd point out belligerently.

Fed up, Nehring resigned in January 1982.[30] Six weeks later, in a howling blizzard kicking up fifty-foot waves, the Ocean Ranger capsized and sank, killing everyone on board. A wave laden with chunks of ice smashed a porthole, splashing water on electrical panels and short-circuiting them. The valves that controlled the level attitude of the rig started to go haywire and the vessel tilted forward into the waves, taking on more water. Lacking survival suits or Coast Guard-approved lifeboats, eighty-four workers plunged into the waters, where the frigid temperatures struck them unconscious then killed them fifteen minutes later.[31]

Back on land, newly made widows took in the news. "I felt like my insides were made of paper, very white paper. I would even walk carefully in case something might rip inside," recalls one.[32]

A year and a half later, the vessel bubbled up to the surface once more. Obscenely it emerged from the depths, upside down, pontoons jutting into the air. Tug boats attempted to tow the monolith farther out to sea. But the Ranger couldn't be pried from the Grand Banks. It broke free over the banks' southern tip, and sank once again.[33]

Such tragic mishaps were compounded by expensive errors. In the early 1980s, oil companies spent over $2 billion building a gravel

island fourteen miles off the north coast of Alaska and drilling into the freezing waters, looking for what they hoped would be an oilfield as big as the ones in Saudi Arabia. But the moving rock layers had tilted, and the migrating oils had spilled out, either being entrapped somewhere else or simply leaking and dispersing at the surface. The oil had been there, but the trap had failed. "We drilled in the right place," said one oil company executive. "We were simply 30 million years too late."[34]

All told, the stream of oil from the industry's discoveries after 1970 comprise less than a third of the oil powering humans and their machines, most of it from small fields that would peak and deplete rapidly.[35] In some instances, oil companies would end up burning more fuel digging and pumping oil from deeply buried fields than the sought-after wells themselves would provide.[36]

Yet it would make huge amounts of money for the companies. After all, the industry could wow its investors with finds of 500 million barrels or even less. At twenty bucks a barrel, such a find was a $10 billion asset. In terms of potential profit for the companies, these finds surely deserved the superlatives heaped upon them by companies and the news media. But in terms of global oil supply, world oil consumption, or the global distribution of oil resources—500 million barrels could slake today's global thirst for oil for about a week and was less than 0.1 percent of the amount of oil collected under the Middle East—the finds were miniscule.[37]

The Arab oil embargo, for all the panic and mayhem it triggered, had cut the flow of oil to the world market by a measly 7 percent, as non-OPEC suppliers upped their oil production to counteract the OPEC cuts. Had Western oil consumption been anything near temperate, this temporary constriction in the flow of oil may have been vaguely tolerable.[38] Instead, successive Western administrations lived in fear of a repeat of the 1970s oil shocks, shaping their military budgets, foreign policies, and economic packages in order to counter the perceived threat of its return.

CHAPTER FOUR

Rockefeller's Ghost

As THE 1980S rolled around, inflation started to let up. New oil from Alaska, the North Sea, and elsewhere started to tip the scales away from OPEC oil, which by the early 1980s accounted for roughly one-fifth of the daily American oil diet.[1] By the time Ronald Reagan took the White House, the country was instructed to go back to doing what it did best: driving cars around and shopping. Reagan brushed off the cautious energy conservatism of the 1970s like unsightly dandruff. He ostentatiously removed the solar panels on the White House roof,[2] and let the energy efficiency requirements pioneered in the 1970s expire. The country didn't need an energy policy, Reagan thought, just "strategic reserves and strategic forces," as his budget director put it.[3]

By the end of the 1980s, the price of oil had fallen below the price of bottled water, and a network of American military bases, aircraft carriers, and warships ringed the Middle East's oilfields, guns at the ready should any trouble arise.[4]

In August 1990, the wrath of the Carter Doctrine fell upon Iraq when it attempted to annex neighboring oil-rich Kuwait. The United States responded with deadly force, followed by a regime of sanctions and years of aerial bombing.

Amenable Gulf countries such as Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates were armed to the teeth so they could help the United States take on any trouble from Iraq, Iran, or other potential troublemakers in the Gulf. Between 1990 and 1997, the United States handed over more than $42 billion worth of weapons and ammunitions to these countries, in the largest arms transfer from any single supplier to any one region of the world ever, according to international security expert Michael T. Klare.[5]

After the dismemberment of Standard Oil, the world's first Big Oil company, the company's constituent parts survived separately as Exxon, Mobil, Chevron, Amoco, Sunoco, and Conoco. In 1999, amidst increasing demand for oil, Exxon and Mobil merged. Two years later, Chevron merged with Texaco. Rockefeller's ghost was rising; Big Oil was back.[6]

By 2001, oil companies penetrated slicks of oily rock in more than eighty countries from four thousand oilfields.[7] The lucrative hunt put the oil industry, valued at between $2 and $5 trillion, in control of almost a sixth of the global economy.[8] ExxonMobil's returns on investments made over the past three decades were nearly *triple* that of other top companies. According to ExxonMobil's letter to its shareholders, the oil leviathan was the most profitable company in the United States.[9]

That year, humans burned over 25 billion barrels of oil. The United States was by far the most prolific. On average, each American man, woman, and child accounted for 3 gallons of oil consumption every day of the year, compared to the average Italian, who burned just 1.4 gallons a day, the average South African and Brazilian less than 0.5 gallons a day, and the average Chinese about .15 gallons a day.[10]

The business of domestic trade in the United States relies almost completely on diesel-burning trucks, which convey 70 percent of the nation's goods from remote factories and farms. Trucks traveled twice as far as the average car with about a quarter of the fuel efficiency: just under six miles to the gallon in 2000.[11] But their numbers—21 million in 2000—paled in comparision to the armadas of cars.

The American automobile market had been technically saturated by 1990, when the average American household owned one car for each of its licensed drivers. And yet, Americans kept buying more cars.

The population growth of cars shot ahead of the population growth of the humans, with a new car rolling into driveways every three seconds whereas new babies appear only every eight seconds.[12]

Gone are the "family pleasure drives" of the 1950s. In 2001, American adults spent more time in their cars than with their children. Yet all the extra driving isn't transporting Americans any farther. Between 1995 and 2001, Americans spent 10 percent more time in their cars but traveled the same number of miles. Americans' beloved cars were meant to herald liberation, yet the faster this freedom spread, the more often drivers found themselves trapped in congestion. Americans burn over half a billion barrels of oil a year just getting to work; they burn another 12 million barrels idling in traffic.[13]

The way Americans live chains them to their cars, whether beloved or not. "I have to have my car," complained one driver. "I need it to get to the hospital, or see my family, or take my wife to a nice dinner," the eighty-year-old man said. "It's not a luxury. It's a big part of my life."[14]

Belching fumes into the air, crashing into each other, cars and trucks kill more than seventy thousand Americans every year.[15] And the cars are growing. Rather than continue their losing competition with more efficient Japanese cars, U.S. automakers tweaked the towering vehicles originally designed for the military into luxury four-wheel-drive cars dubbed "sports utility vehicles" and marketed them to sporty urbanites and safety-conscious families.

Between 1980 and 2000, automakers spent $80 billion advertising large cars and trucks, and between 1995 and 2001, the number of SUVs on American roads doubled while vans and pickups increased by more than 20 percent. "You put a few more bucks into a car, enlarge it, and sell it for a lot more money," explained a marketing director from Chrysler. "There was no actual customer need for four-wheel drive," added a Jeep executive. "All of the SUV market was psychological." The gas-guzzling SUVs had been classified by Congress as "light trucks," and thus were exempt from the more stringent fuel economy standards

required for passenger cars, regulators perhaps reasoning that SUVs would never appeal to anyone outside of farmers and horse-owners. But by the time sales had started to skyrocket among urbanites, the Environmental Protection Agency (EPA) found it difficult to crack down. As an unnamed EPA official admitted to *New York Times* auto reporter Keith Bradsher: "We don't want to kill the goose that lays the golden eggs for the domestic [auto] industry."[16] With an average fuel efficiency 20 percent less than the average passenger car, SUV sales pulled down the average fuel efficiency of the nation's light vehicles, which declined steadily from 1988 onwards.[17]

More stringent fuel efficiency standards alone would probably not stem the oil bonanza in any case. Many technologies that let energy be used more efficiently had had the vaguely counterintuitive effect of actually increasing energy consumption, a turnaround noticed by scholars over a century ago. In 1865, many believed that technological progress in making engines more efficient and the like would reduce future coal consumption. But in fact just the opposite occurred. The more efficiently energy could be harnessed, the more savvy marketers would encourage people to consume. Energy analysts called it "Jevons' paradox." More efficient refrigeration technology led manufacturers to market bigger refrigerators, and more fuel-efficient cars led Americans to step up their leisure driving, they found. As long as more efficient technology drove prices down, the technology stimulated more energy consumption, not less.[18]

Today, crude has become so indispensable to American society that even temporary interruptions in the flow of oil can seem dire.

On July 30, 2003, for instance, a pipeline carrying gasoline from Tucson to Phoenix ruptured and had to be shut down, depriving Phoenix of one-third of its gasoline supply. Panicked drivers waited in lines at gasoline stations for hours, only to find the pumps had run dry. "I never knew that gas was going to seem like gold," said one alarmed SUV driver.[19]

Bereft of cheap plentiful gasoline for their commutes to work, many Phoenix residents were forced to improvise. Within the living memory of some Phoenix residents, automakers and oil companies had felt they had to trick commuters into driving cars rather than taking public transit, but now, stumbling onto exotic-seeming public buses, Phoenix residents had little notion about how to behave, prompting local newspaper reporters to offer helpful tips. "As the bus approaches, signal the operator to stop," read one bit of news media advice, "by waving."[20]

The state's worried governor looked at the lengthening gas lines and cancelled her own travel plans, assuring Phoenix drivers that the gasoline supply would be quickly restored and that rationing "is nowhere near the top of the list" of solutions to the problem.

Although it isn't easy to opt out of Western car culture, neither is it impossible. Frank Hewetson, father of two, built extra seats into the back seat of his car. "The school run, if you are doing it just you and one kid," he proclaimed, "is fairly outrageous." And so, every day, he'd round up five more kids to pile into his car and drive to school, figuring he was at least helping remove a few cars from the congested roads. But then he'd be forced to drive on to work, "sitting there alone in the car, feeling really guilty." And once at work, he'd sometimes have to drive more.

Luckily, his employers had an old black tank in the corner of the yard. Every so often an outfit that collected the leftover cooking oil from fish-and-chip shops and converted it into biodiesel would come and pour the fuel into the tank. Hewetson didn't feel so guilty driving the company car around, burning old recycled fish-and-chip-shop oil rather than gasoline. Plus, he added, the exhaust smelled like french fries.

Along with domestic trade and the daily grind, the daily bread has become a daily toll for the oil industry. In 2000, industrial farmers around the world spread over 85 million tons of nitrogen fertilizer on their lands, requiring over half a billion barrels of petroleum.[21] In the end, the petrofoods they produced provided just one kilocalorie for every ten kilocalories put in to grow them, a complete reversal from the times when humans stalked their prey and tilled their small plots, expending one-tenth the energy they'd reap in food.

Nitrogen fertilizers increase yields at first, but over time, farmers have had to apply more and more in order to sustain the incredible bounty of the first harvests. In 2001, industrial farmers inundated their soils with thirteen times more nitrogen than would ultimately end up stored in the tissues of the humans who ate their crops, and the potent runoff of this excess of nitrogen poisoned both land and water.[22]

Today, Americans eat food that has typically traveled between 1,500 and 2,500 miles to get from the farm to their plates. With abundant plastics for packaging and plenty of cheap oil and trucks, the network of factories, farms, and supermarkets that keeps Americans fed has had no reason not to spread out lazily. Centralized supermarkets ensure that even organic and locally grown foods incur a petroleum cost. If nearby farmers want to sell food to their neighbors through the local store, they must ship their produce hundreds of miles to and from centralized inspection centers first.[23]

Plastic packaging makes it possible for these foods to remain somewhat edible, but long-distance petrofoods are by necessity more processed and homogeneous than seasonally available local foods. American hybrid corn is a good example. Almost a fifth of the country's arable land is planted with corn, a crop that requires more petrofertilizers and pesticides than any other, packing more than a half-gallon into every bushel.[24] It isn't that Americans eat so much corn, as corn. American fossil-fuel-grown corn is an abundant feedstock to process and transform into myriad processed foods. Most animals raised for meat are fed corn, even if they then require

antibiotics to tolerate the illnesses to which the corn diet makes them vulnerable. Even farmed fish are fed corn. Syrup made from corn saturates sodas, sweets, and snacks.[25]

The predominant activity of the modern industrial economy has become combustion. No less than 40 percent of the matter pumping through American society's veins is oil; 80 percent of its wastes are the smoky end-products of combustion. "Modern industrial economies, no matter how high-tech, are carbon-based economies," the World Resources Institute reported, "and their predominant activity is burning material."[26] The amount of energy in the crude oil that goes into U.S. refineries and chemicals factories is matched, one to one, with the amount of energy they need to consume to keep functioning.[27]

On the smoky margins of this global bonfire, Frank Hewetson, a tall, balding, fit man in his thirties, dons a dry suit and life jacket, and throws himself into the freezing North Atlantic, directly into the path of a giant tugboat pulling a towering oil rig into place. He floats in the water for hours, leaning his head back and staring at the stars. In the pit of his belly, he can feel the shock waves of seismic surveyors' blasting airguns, an experience he describes as surreal.

He delays the ships, for a time, but eventually Hewetson gets carted off.

As an activist with Greenpeace UK, Hewetson and his colleagues resist Western carbon-burning culture in a most visceral way. Their plans include campaigns much more ambitious than simply freezing in the dark North Atlantic sea; Hewetson and his colleagues board and occupy oil rigs themselves, using the most high-tech materials and machines produced by the hydrocarbon economy to do it.

"If the rig was working, we would be fairly worried about going anywhere near it with our petrol boats," he says.[28] So, slowly, they move in with their diesel boats, with their sparkless ignition systems.

If the weather is good, they maneuver the small boats near the gigantic steel legs of the rig. Beams, giant chains, and pipes dangle from all directions in the shady waters under the rig. The waves pound the little boat. The currents under the rig threaten to capsize the boat, sucking it under the rig's metal maze.

Hewetson jumps to the rig followed by two others. On his back he carries climbing equipment, drysuits, and food:

> We actually climbed up the anchor chain itself, which was quite scary because it was moving around. Each link is about two to three feet big, and we just free climbed it, basically. We tried to make our way up to the working platform, but the workers were stopping us, physically getting in the way, so we came back down.

On the way down, Hewetson spies a small metal balcony, "tucked up right inside where the chains were." He squeezes his sleeping bag out of his pack and "made myself a home." He stays there for a few days, one worker even surreptitiously handing him a hot cup of coffee. His presence stops the rig from working for a few days, bleeding precious summer working hours in the process.

Later, Hewetson's group hatched a plan even more audacious. They would hoist a self-contained pod, a rigid, well-equipped, airtight camping tent, onto one of the rigs. This would provide for a much sturdier, more permanent occupation than an impromptu sleeping bag. If they could somehow attach the pod to an oil rig, they might be able to stymie oil production for days or even weeks.

An aeronautics engineer designed and built the pod from bright yellow Kevlar, a bullet-proof fabric made possible by oil's bounty. One morning, Hewetson and the others set off to affix the yellow blister to the side of an unsuspecting rig. "We climbed up the oil rig and put a big pulley there. Then we took a rope from the boat through the pulley and down onto the pod, so when the boat went off, the pod went up and we roped it in."

Hewetson and the others maneuvered themselves onto the tiny yellow pod, clinging to the side of the rig high above the seas. They shut the hatch and sat tight. If they hung on long enough, the calls for radio interviews would start streaming in on the satellite phone they had set up in the pod.

Suddenly, a powerful spray of water rained down on them. The workers were hosing the pod, like old cobwebs under the porch. They'd positioned a crane nearby, set to pull the pod off the rig, with a net underneath to catch the activists should they fall out.

Hewetson, realizing their plan, strapped on a rope and jumped out of the pod. "I tied the whole net in a big knot. It was just a useless bunch of rope then." Later, the oil company took more aggressive action. They sent some people down on ropes to stand on the pod's hatch, trapping Hewetson and the others inside. Then, with the activists trapped inside the pod, they craned the whole thing up onto the platform. They smashed open the hatch and grabbed the activists out. The police took over.

That was the last Hewetson saw of the Kevlar pod. Exhausted, out of fuel and batteries, the M V *Greenpeace* steamed home.

The oil industry said that the West's giant, self-reinforcing edifice built of black grease brought prosperity, pointing to the strong link between G N P growth and oil consumption. The more oil countries consumed, the more their G N P would shoot up. The more fuel workers consumed, with bigger and more fuel-intensive machines, the more productive they were. The correlation had been well-documented for decades.[29]

Critics wondered whether a rising G N P indicated genuine growth or a mere "swelling." Running up an $11 billion medical bill treating the childhood asthma epidemic triggered in part by trucks' diesel fumes added to the growth of the G N P, after all.[30] Such dilemmas were mostly brushed aside, most aggressively by those in the oil

industry. According to Rex Tillerson, the swaggering Texan vice president of ExxonMobil, the world would descend into poverty and insecurity if the oil industry were not allowed to hunt, track, and plunge their drills into every last corner of the earth. "It is clear that the discovery and growing use of hydrocarbons over the last century has contributed greatly to people's wellbeing," Tillerson said in February 2003. "Access to affordable and reliable energy supply remains essential to the continued progress, prosperity, and well being of the world's citizens." Regulations based on "misplaced" environmental concerns would waste the "limited resources" of private oil companies, restricting their ability to "provide the greatest good to society."[31]

Promoting variations on this argument, the U.S. government and the international lending institutions it dominates have ensured that the fossil-fuel economy doesn't end at Western borders, by affixing thick, oil-soaked strings to its loans to indebted developing countries. Between 1992 and 2002, American export credit agencies handed out over $30 billion for fossil-fuel projects to developing countries; the World Bank almost $25 billion. It is one hundred times more than the Bank doles out for renewable energy projects, according to one analysis.[32]

Ensuring that developing countries consume increasing quantities of oil is "crucial to the long-term growth of oil markets," the U.S. Department of Energy opined.[33] Carmakers and oil companies know that the next hot market for them is unlikely to be in the West, given that each licensed driver in the United States already owns a car. In 2000, automakers spent almost $10 billion advertising their cars outside the United States.[34] China, in particular, "offers huge potential for future growth" BP's annual report avowed.[35]

Today, congested, slum-ridden megacities such as Calcutta and Jakarta are rapidly vanquishing their well-trod footpaths and bike alleys for asphalt-paved roads for cars driven by the elite.[36] The effects can be seen from miles above the planet.

Ram Ramanathan, an atmospheric scientist, gazed out his airplane window, heading south from Mumbai, India. The thick brown city haze, from hundreds of millions of wood fires and flaming cow-dung patties, sped past the plane's oval windows as it climbed over the Indian Ocean. But almost a thousand miles later, as the plane glided over the open sea, the brown pall still hadn't lifted. "This is something big," he thought to himself.

Dust, ash, and smoke from Asia's poorly regulated industries have congealed into a giant dark cloud of smog, blocking out as much as 10 percent of India's sunlight. Ramanathan had flown through the two-mile-thick "Asian brown cloud," a permanent fixture now stretching thousands of miles over the skies of Asia.[37]

By 2020, the developing countries, led by China and India, are expected to consume almost 90 percent as much oil as the industrialized countries.[38] The growth in their demand for oil could outstrip oil demand growth in the West by almost two to one. It is only natural, according to the U.S. Department of Energy. Growing populations and burgeoning industrial economies in China, India, and the rest led to "rapidly rising consumer demand for transportation via cars and trucks powered with internal combustion engines."[39]

CHAPTER THREE

Into the Cold

By 1973, the earth's crust was bleeding more than 55 million barrels of oil every day, over half of it from the Middle East.[1] With each barrel swallowed by the industrial world's roaring machines, there wasn't a drop to spare.

Then, in October of that year, Egypt and Syria attacked Israel, attempting to recapture territories lost in 1967.[2] The United States promptly arranged for aid to be sent to Israel.

For the ministers in a then-obscure cartel called OPEC, this was just too much. They decided to take a stand. What they did would make OPEC "a household word, not just an obscure acronym," noted the *National Petroleum News*, turning Western attention to the distant lands they unknowingly relied on "for the first time."[3] Several OPEC ministers voted to cauterize the arteries pumping life-blood to Israel's allies, embargoing shipments of oil to the United States and the Netherlands.

Over the next six months, the price of the now much scarcer oil skyrocketed from $3 to almost $12 a barrel. The effect on industrial oil-gorging economies was tremendous and long-lasting. Almost every product by then came with an embedded oil cost.[4] Between 1970 and 1980, consumer prices doubled. Unemployment rose. Inflation set in.[5]

Then-President Nixon considered forcibly seizing Middle Eastern oilfields, but American soldiers were already stuck in a costly unpopular war in Southeast Asia.[6] What else could the United States do? Its own once-prodigious oilfields were in decline, North Sea and Alaskan oil had yet to come into full production, and the country relied on imported oil for almost a third of its oil.[7] They'd have to

settle for a slow buildup of forces in the region: maybe they'd be better prepared next time.[8]

In the meantime, as prices kept rising, the government reluctantly did the obvious: institute measures to curb energy consumption. Nixon instructed homeowners to turn their thermostats down and companies to shorten working hours. Gas stations were to ration each driver to just ten gallons each. No gasoline would be sold on Sundays. For the first time, vehicles would have to meet some minimum efficiency requirements. Later, President Carter would urge energy conservation, appearing on national television wearing woolly sweaters in the chilly White House. He pressured companies to reverse their historic switch from coal to oil and gas—and to go back to coal. In 1978, he instituted the "gas guzzler" tax, a penalty leveled at those who bought inefficient cars.[9]

"Governments, corporations, and individuals were entirely unprepared for this turn of events," writes historian David Hackett Fischer. "Many American families found their budgets strained beyond the breaking point."[10] A new government agency was formed to study how energy was used in the economy—it would come to be called the Department of Energy.[11] A new way of thinking about energy, power, and society sprang up in the book-lined thinktanks and universities, with groundbreaking works from political philosopher Ivan Illich, biophysicist Donella Meadows, economist Herman Daly, and others. But none of it made much sense to insular, oil-coddled Americans. Commented one finance writer, "To many Americans it was impossible to understand how their standard of living was now being held hostage to obscure border clashes in strange parts of the world."[12] Broke and uncomprehending, they waited impatiently in the endless lines at the gas stations. Disappointment turned to pessimism, and a widespread cynicism set in.[13]

President Gerald Ford instituted a stockpile of oil, to be used in a future emergency: the Strategic Petroleum Reserve. Ultimately, several billion barrels of oil would be squirreled away in Louisiana's salt domes for safekeeping should capricious oil suppliers play dirty again. The industrialized countries that depended on OPEC oil formed their own alliance to counter the cartel, the International Energy Agency.

The second "oil shock" arrived in 1979 when Islamic fundamentalists overthrew the Shah of Iran. America's shaking hand curled into a fist. Carter announced what came to be known as the "Carter Doctrine." From then on, the policy of the United States would be to smother any hostile act that might curb the flow of the Gulf's oil using "any means necessary."[14]

However dispiriting and difficult the 1970s oil shocks were to Americans, they were much worse on the countries of the developing world. Poorer countries couldn't simply cut back on Sunday driving in order to weather a quadrupling of oil prices. Their newly industrializing factories needed the oil to function. The oil-intensive mode of growing food prevalent in the West had taken hold, and those who eked out a life growing their own food on small plots had seen their lands bulldozed by the oil-fired machines, sprayed with oil-derived fertilizers and pesticides, and their monoculture crops carted off on oil-burning trucks and planes. Amidst the plenty that petroagriculture made possible, one out of every seven human beings still went hungry, yet at least in the short term, industrial farms would demand their crude to avert potentially even greater catastrophe.[15] Many Third World governments borrowed billions of dollars from commercial banks and institutions to pay for the expensive oil imports.[16]

A crushing debt grew. In 1970, the developing economies of the Third World had a manageable external debt, approximately $100 million. By 1988, the Third World's external debt had grown to a staggering $1.3 trillion. Just paying the interest on these loans constituted a massive transfer of wealth from the countries of the South to the bankers of the North.[17]

Meanwhile, the oil industry was enjoying golden years. Flush with

cash from the pricey oil that was dragging so many economies down, oil companies invested in developing their perilous but politically safe treasure chests in Alaska and the North Sea.

In hot pursuit of "energy independence," the nation's new battle cry, Congress had decreed that the trans-Alaskan pipeline be given the go-ahead.[18] The old gangs from Saudi Arabia were resurrected. A $50 billion matrix of roads, rigs, and machines rapidly colonized the windswept, icy, coastal plains, ferrying in drawling cowboy-booted oilmen from the south. "The whiteout blend[ed] sky and earth in a deafening whiteness," remembers one oil consultant, fondly. "And here, where the opposite extremes of earth are found, here you find the commonality of the drilling rig and its crew, the buddies of those in Arabia. Some have been there themselves. I hear[d] the drawl, and I [saw] the cowboy boots and the tobacco spit again."[19]

The clouds of dust following the zooming trucks and tankers sent the wildlife running, hunters finally penetrating the tundra on the new roads made for oil. The oil empire exhaled almost a hundred thousand tons of pollutants into the cold air every year and leaked over a million barrels of contaminated wastes every day. The native Alaskans watched as strange new sores and lesions befell their moose and caribou, their children started coughing more, and their seals' skins thinned.[20] Yet the industry and the governments that supported it were determined to continue plumbing the most forbidding seas and braving the most extreme climates in pursuit of crude anywhere in the world—except for in OPEC countries.

The triangular island of Newfoundland lies off the eastern edge of Canada in the frigid North Atlantic. It is a snow-covered jag of rock, its poor soils supporting stark pine forests and reindeer-moss covered plateaus. The people who live there, "Newfies," are the poorest and least-employed people in Canada.

One hundred and eighty miles off Newfoundland's southeastern

coast, a series of banks rise off the continental shelf. Cold currents from the Labrador Sea wash over the banks, carrying stately icebergs, broken off the Greenland ice sheet. Meanwhile warm waters pushed by the Gulf Stream rush in from the south. As the frigid waters meet the warm over the shallow banks, clouds of fog are belched into the air, and the waters below start to churn.

This patch of ocean has long been known as "iceberg alley" to the Coast Guard. The lethal combination of shallow water, fog, and icebergs over the banks menaced the busy shipping lanes linking North America to Europe. Some of these ice pillars could be as heavy as 5 million tons, soaring to three hundred feet above the water.[21]

The waters are rich in oxygen and nutrients, providing a perfect medium for plankton, the precursor to a lush food chain. For more than four hundred years, fishermen and women from all over the world braved the seventy-mile-per-hour winds and hundred-foot swells of the largest of the banks, the 350-mile-long Grand Banks, for what was once one of the richest fisheries in the world.[22]

In 1979, Mobil, after drilling and abandoning fifty dry holes, struck oil off the Grand Banks in a field dubbed "Hibernia." The news met with great excitement among political elites, oil execs, and the long-suffering Newfies. Hibernia became the "indisputable darling of Wall Street investors," with commentators guessing the Grand Banks could hold up to 10 billion barrels of oil. This was "big-league stuff," as one analyst gushed.[23]

But how to get it out? In order to drill exploratory wells off the forbidding Grand Banks, oil companies would need a new and improved kind of vessel, one able to withstand the blow of gigantic icebergs. They'd need something much better than the Titanic, which an iceberg had punctured near the banks in 1912, and it wouldn't come cheap. Drilling a single well under the ocean could cost four times more than even the most expensive wells drilled on land.[24]

The truth was that oil companies were extremely cautious about new methods. Mistakes were costly and nobody wanted to ruin a perfectly decent well with some untested gadget, no matter how

efficient or groundbreaking it might be. "Making a huge up-front investment in a technology that might not be commercial for ten years may be a necessity, but it's not a pretty addition to the balance sheet," commented one analyst.[25] By the turn of the millennium, many were still lionizing the breakthroughs that made Halliburton and Schlumberger legendary names in the business, innovations pioneered in the 1920s.[26] As a petroleum engineer put it, the industry was "totally oblivious to other technologies that were not stamped with a big H or a big S."[27]

Oil companies approached the problem of taming the banks' icy tempest the same way they approached others: enlarge. In 1981, Mobil spent almost half a million dollars a day to send a towering rig to drill exploratory wells on the stormy banks. At fifteen thousand tons, the rig, called the Ocean Ranger, was the world's biggest. "The massiveness kind of terrifies you at first," the Ranger's captain admitted.[28] The platform was twice the size of a football field. As one reporter who ventured onboard put it:

> [The Ocean Ranger was] as square and solid as the Parthenon, which, with her eight massive supporting columns, she somewhat resembled. Towering thirty-seven stories from keel to derrick top, moored by twelve anchors with cables each a mile long, the Ranger seemed a temple of stability. Veteran ship captains were amazed to find that she hardly rocked at all, often less than half a degree. But the oil men who ran the Ocean Ranger just propped up their cowboy boots and smiled. Well, Oklahoma didn't move around under your feet, either.[29]

The rig was considered unsinkable.

The ship's able captain boasted forty years of nautical experience, but unlike most other vessels afloat in the sea, the captain didn't have ultimate authority over the Ocean Ranger. The person in charge of the ship wasn't a mariner, but an oilman. Even while drilling miles

away from solid ground, "land-bound, oil-field tradition prevailed," as the *Washington Post* described. Once anchored for drilling, the captain wasn't even required to be on board the Ranger.

The captain watched, dismayed, as routine seagoing protocols fell by the wayside. Reports that the Ranger had discharged a hundred gallons of diesel fuel went unreported to the Coast Guard. The drilling workers wouldn't show up for their lifeboat-skills training. No pumps or alarms stood at the ready should the ship take on water. The captain, Karl Nehring, sometimes complained to the chief oilman about the various safety breaches. "Who's in charge, Karl?" he'd point out belligerently.

Fed up, Nehring resigned in January 1982.[30] Six weeks later, in a howling blizzard kicking up fifty-foot waves, the Ocean Ranger capsized and sank, killing everyone on board. A wave laden with chunks of ice smashed a porthole, splashing water on electrical panels and short-circuiting them. The valves that controlled the level attitude of the rig started to go haywire and the vessel tilted forward into the waves, taking on more water. Lacking survival suits or Coast Guard-approved lifeboats, eighty-four workers plunged into the waters, where the frigid temperatures struck them unconscious then killed them fifteen minutes later.[31]

Back on land, newly made widows took in the news. "I felt like my insides were made of paper, very white paper. I would even walk carefully in case something might rip inside," recalls one.[32]

A year and a half later, the vessel bubbled up to the surface once more. Obscenely it emerged from the depths, upside down, pontoons jutting into the air. Tug boats attempted to tow the monolith farther out to sea. But the Ranger couldn't be pried from the Grand Banks. It broke free over the banks' southern tip, and sank once again.[33]

Such tragic mishaps were compounded by expensive errors. In the early 1980s, oil companies spent over $2 billion building a gravel

island fourteen miles off the north coast of Alaska and drilling into the freezing waters, looking for what they hoped would be an oilfield as big as the ones in Saudi Arabia. But the moving rock layers had tilted, and the migrating oils had spilled out, either being entrapped somewhere else or simply leaking and dispersing at the surface. The oil had been there, but the trap had failed. "We drilled in the right place," said one oil company executive. "We were simply 30 million years too late."[34]

All told, the stream of oil from the industry's discoveries after 1970 comprise less than a third of the oil powering humans and their machines, most of it from small fields that would peak and deplete rapidly.[35] In some instances, oil companies would end up burning more fuel digging and pumping oil from deeply buried fields than the sought-after wells themselves would provide.[36]

Yet it would make huge amounts of money for the companies. After all, the industry could wow its investors with finds of 500 million barrels or even less. At twenty bucks a barrel, such a find was a $10 billion asset. In terms of potential profit for the companies, these finds surely deserved the superlatives heaped upon them by companies and the news media. But in terms of global oil supply, world oil consumption, or the global distribution of oil resources—500 million barrels could slake today's global thirst for oil for about a week and was less than 0.1 percent of the amount of oil collected under the Middle East—the finds were miniscule.[37]

The Arab oil embargo, for all the panic and mayhem it triggered, had cut the flow of oil to the world market by a measly 7 percent, as non-OPEC suppliers upped their oil production to counteract the OPEC cuts. Had Western oil consumption been anything near temperate, this temporary constriction in the flow of oil may have been vaguely tolerable.[38] Instead, successive Western administrations lived in fear of a repeat of the 1970s oil shocks, shaping their military budgets, foreign policies, and economic packages in order to counter the perceived threat of its return.

CHAPTER FOUR

Rockefeller's Ghost

As THE 1980S rolled around, inflation started to let up. New oil from Alaska, the North Sea, and elsewhere started to tip the scales away from OPEC oil, which by the early 1980s accounted for roughly one-fifth of the daily American oil diet.[1] By the time Ronald Reagan took the White House, the country was instructed to go back to doing what it did best: driving cars around and shopping. Reagan brushed off the cautious energy conservatism of the 1970s like unsightly dandruff. He ostentatiously removed the solar panels on the White House roof,[2] and let the energy efficiency requirements pioneered in the 1970s expire. The country didn't need an energy policy, Reagan thought, just "strategic reserves and strategic forces," as his budget director put it.[3]

By the end of the 1980s, the price of oil had fallen below the price of bottled water, and a network of American military bases, aircraft carriers, and warships ringed the Middle East's oilfields, guns at the ready should any trouble arise.[4]

In August 1990, the wrath of the Carter Doctrine fell upon Iraq when it attempted to annex neighboring oil-rich Kuwait. The United States responded with deadly force, followed by a regime of sanctions and years of aerial bombing.

Amenable Gulf countries such as Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates were armed to the teeth so they could help the United States take on any trouble from Iraq, Iran, or other potential troublemakers in the Gulf. Between 1990 and 1997, the United States handed over more than $42 billion worth of weapons and ammunitions to these countries, in the largest arms transfer from any single supplier to any one region of the world ever, according to international security expert Michael T. Klare.[5]

After the dismemberment of Standard Oil, the world's first Big Oil company, the company's constituent parts survived separately as Exxon, Mobil, Chevron, Amoco, Sunoco, and Conoco. In 1999, amidst increasing demand for oil, Exxon and Mobil merged. Two years later, Chevron merged with Texaco. Rockefeller's ghost was rising; Big Oil was back.[6]

By 2001, oil companies penetrated slicks of oily rock in more than eighty countries from four thousand oilfields.[7] The lucrative hunt put the oil industry, valued at between $2 and $5 trillion, in control of almost a sixth of the global economy.[8] ExxonMobil's returns on investments made over the past three decades were nearly *triple* that of other top companies. According to ExxonMobil's letter to its shareholders, the oil leviathan was the most profitable company in the United States.[9]

That year, humans burned over 25 billion barrels of oil. The United States was by far the most prolific. On average, each American man, woman, and child accounted for 3 gallons of oil consumption every day of the year, compared to the average Italian, who burned just 1.4 gallons a day, the average South African and Brazilian less than 0.5 gallons a day, and the average Chinese about .15 gallons a day.[10]

The business of domestic trade in the United States relies almost completely on diesel-burning trucks, which convey 70 percent of the nation's goods from remote factories and farms. Trucks traveled twice as far as the average car with about a quarter of the fuel efficiency: just under six miles to the gallon in 2000.[11] But their numbers—21 million in 2000—paled in comparision to the armadas of cars.

The American automobile market had been technically saturated by 1990, when the average American household owned one car for each of its licensed drivers. And yet, Americans kept buying more cars.

The population growth of cars shot ahead of the population growth of the humans, with a new car rolling into driveways every three seconds whereas new babies appear only every eight seconds.[12]

Gone are the "family pleasure drives" of the 1950s. In 2001, American adults spent more time in their cars than with their children. Yet all the extra driving isn't transporting Americans any farther. Between 1995 and 2001, Americans spent 10 percent more time in their cars but traveled the same number of miles. Americans' beloved cars were meant to herald liberation, yet the faster this freedom spread, the more often drivers found themselves trapped in congestion. Americans burn over half a billion barrels of oil a year just getting to work; they burn another 12 million barrels idling in traffic.[13]

The way Americans live chains them to their cars, whether beloved or not. "I have to have my car," complained one driver. "I need it to get to the hospital, or see my family, or take my wife to a nice dinner," the eighty-year-old man said. "It's not a luxury. It's a big part of my life."[14]

Belching fumes into the air, crashing into each other, cars and trucks kill more than seventy thousand Americans every year.[15] And the cars are growing. Rather than continue their losing competition with more efficient Japanese cars, U.S. automakers tweaked the towering vehicles originally designed for the military into luxury four-wheel-drive cars dubbed "sports utility vehicles" and marketed them to sporty urbanites and safety-conscious families.

Between 1980 and 2000, automakers spent $80 billion advertising large cars and trucks, and between 1995 and 2001, the number of SUVs on American roads doubled while vans and pickups increased by more than 20 percent. "You put a few more bucks into a car, enlarge it, and sell it for a lot more money," explained a marketing director from Chrysler. "There was no actual customer need for four-wheel drive," added a Jeep executive. "All of the SUV market was psychological." The gas-guzzling SUVs had been classified by Congress as "light trucks," and thus were exempt from the more stringent fuel economy standards

required for passenger cars, regulators perhaps reasoning that SUVs would never appeal to anyone outside of farmers and horse-owners. But by the time sales had started to skyrocket among urbanites, the Environmental Protection Agency (EPA) found it difficult to crack down. As an unnamed EPA official admitted to *New York Times* auto reporter Keith Bradsher: "We don't want to kill the goose that lays the golden eggs for the domestic [auto] industry."[16] With an average fuel efficiency 20 percent less than the average passenger car, SUV sales pulled down the average fuel efficiency of the nation's light vehicles, which declined steadily from 1988 onwards.[17]

More stringent fuel efficiency standards alone would probably not stem the oil bonanza in any case. Many technologies that let energy be used more efficiently had had the vaguely counterintuitive effect of actually increasing energy consumption, a turnaround noticed by scholars over a century ago. In 1865, many believed that technological progress in making engines more efficient and the like would reduce future coal consumption. But in fact just the opposite occurred. The more efficiently energy could be harnessed, the more savvy marketers would encourage people to consume. Energy analysts called it "Jevons' paradox." More efficient refrigeration technology led manufacturers to market bigger refrigerators, and more fuel-efficient cars led Americans to step up their leisure driving, they found. As long as more efficient technology drove prices down, the technology stimulated more energy consumption, not less.[18]

Today, crude has become so indispensable to American society that even temporary interruptions in the flow of oil can seem dire.

On July 30, 2003, for instance, a pipeline carrying gasoline from Tucson to Phoenix ruptured and had to be shut down, depriving Phoenix of one-third of its gasoline supply. Panicked drivers waited in lines at gasoline stations for hours, only to find the pumps had run dry. "I never knew that gas was going to seem like gold," said one alarmed SUV driver.[19]

Bereft of cheap plentiful gasoline for their commutes to work, many Phoenix residents were forced to improvise. Within the living memory of some Phoenix residents, automakers and oil companies had felt they had to trick commuters into driving cars rather than taking public transit, but now, stumbling onto exotic-seeming public buses, Phoenix residents had little notion about how to behave, prompting local newspaper reporters to offer helpful tips. "As the bus approaches, signal the operator to stop," read one bit of news media advice, "by waving."[20]

The state's worried governor looked at the lengthening gas lines and cancelled her own travel plans, assuring Phoenix drivers that the gasoline supply would be quickly restored and that rationing "is nowhere near the top of the list" of solutions to the problem.

Although it isn't easy to opt out of Western car culture, neither is it impossible. Frank Hewetson, father of two, built extra seats into the back seat of his car. "The school run, if you are doing it just you and one kid," he proclaimed, "is fairly outrageous." And so, every day, he'd round up five more kids to pile into his car and drive to school, figuring he was at least helping remove a few cars from the congested roads. But then he'd be forced to drive on to work, "sitting there alone in the car, feeling really guilty." And once at work, he'd sometimes have to drive more.

Luckily, his employers had an old black tank in the corner of the yard. Every so often an outfit that collected the leftover cooking oil from fish-and-chip shops and converted it into biodiesel would come and pour the fuel into the tank. Hewetson didn't feel so guilty driving the company car around, burning old recycled fish-and-chip-shop oil rather than gasoline. Plus, he added, the exhaust smelled like french fries.

Along with domestic trade and the daily grind, the daily bread has become a daily toll for the oil industry. In 2000, industrial farmers around the world spread over 85 million tons of nitrogen fertilizer on their lands, requiring over half a billion barrels of petroleum.[21] In the end, the petrofoods they produced provided just one kilocalorie for every ten kilocalories put in to grow them, a complete reversal from the times when humans stalked their prey and tilled their small plots, expending one-tenth the energy they'd reap in food.

Nitrogen fertilizers increase yields at first, but over time, farmers have had to apply more and more in order to sustain the incredible bounty of the first harvests. In 2001, industrial farmers inundated their soils with thirteen times more nitrogen than would ultimately end up stored in the tissues of the humans who ate their crops, and the potent runoff of this excess of nitrogen poisoned both land and water.[22]

Today, Americans eat food that has typically traveled between 1,500 and 2,500 miles to get from the farm to their plates. With abundant plastics for packaging and plenty of cheap oil and trucks, the network of factories, farms, and supermarkets that keeps Americans fed has had no reason not to spread out lazily. Centralized supermarkets ensure that even organic and locally grown foods incur a petroleum cost. If nearby farmers want to sell food to their neighbors through the local store, they must ship their produce hundreds of miles to and from centralized inspection centers first.[23]

Plastic packaging makes it possible for these foods to remain somewhat edible, but long-distance petrofoods are by necessity more processed and homogeneous than seasonally available local foods. American hybrid corn is a good example. Almost a fifth of the country's arable land is planted with corn, a crop that requires more petrofertilizers and pesticides than any other, packing more than a half-gallon into every bushel.[24] It isn't that Americans eat so much corn, as corn. American fossil-fuel-grown corn is an abundant feedstock to process and transform into myriad processed foods. Most animals raised for meat are fed corn, even if they then require

antibiotics to tolerate the illnesses to which the corn diet makes them vulnerable. Even farmed fish are fed corn. Syrup made from corn saturates sodas, sweets, and snacks.[25]

The predominant activity of the modern industrial economy has become combustion. No less than 40 percent of the matter pumping through American society's veins is oil; 80 percent of its wastes are the smoky end-products of combustion. "Modern industrial economies, no matter how high-tech, are carbon-based economies," the World Resources Institute reported, "and their predominant activity is burning material."[26] The amount of energy in the crude oil that goes into U.S. refineries and chemicals factories is matched, one to one, with the amount of energy they need to consume to keep functioning.[27]

On the smoky margins of this global bonfire, Frank Hewetson, a tall, balding, fit man in his thirties, dons a dry suit and life jacket, and throws himself into the freezing North Atlantic, directly into the path of a giant tugboat pulling a towering oil rig into place. He floats in the water for hours, leaning his head back and staring at the stars. In the pit of his belly, he can feel the shock waves of seismic surveyors' blasting airguns, an experience he describes as surreal.

He delays the ships, for a time, but eventually Hewetson gets carted off.

As an activist with Greenpeace UK, Hewetson and his colleagues resist Western carbon-burning culture in a most visceral way. Their plans include campaigns much more ambitious than simply freezing in the dark North Atlantic sea; Hewetson and his colleagues board and occupy oil rigs themselves, using the most high-tech materials and machines produced by the hydrocarbon economy to do it.

"If the rig was working, we would be fairly worried about going anywhere near it with our petrol boats," he says.[28] So, slowly, they move in with their diesel boats, with their sparkless ignition systems.

If the weather is good, they maneuver the small boats near the gigantic steel legs of the rig. Beams, giant chains, and pipes dangle from all directions in the shady waters under the rig. The waves pound the little boat. The currents under the rig threaten to capsize the boat, sucking it under the rig's metal maze.

Hewetson jumps to the rig followed by two others. On his back he carries climbing equipment, drysuits, and food:

> We actually climbed up the anchor chain itself, which was quite scary because it was moving around. Each link is about two to three feet big, and we just free climbed it, basically. We tried to make our way up to the working platform, but the workers were stopping us, physically getting in the way, so we came back down.

On the way down, Hewetson spies a small metal balcony, "tucked up right inside where the chains were." He squeezes his sleeping bag out of his pack and "made myself a home." He stays there for a few days, one worker even surreptitiously handing him a hot cup of coffee. His presence stops the rig from working for a few days, bleeding precious summer working hours in the process.

Later, Hewetson's group hatched a plan even more audacious. They would hoist a self-contained pod, a rigid, well-equipped, airtight camping tent, onto one of the rigs. This would provide for a much sturdier, more permanent occupation than an impromptu sleeping bag. If they could somehow attach the pod to an oil rig, they might be able to stymie oil production for days or even weeks.

An aeronautics engineer designed and built the pod from bright yellow Kevlar, a bullet-proof fabric made possible by oil's bounty. One morning, Hewetson and the others set off to affix the yellow blister to the side of an unsuspecting rig. "We climbed up the oil rig and put a big pulley there. Then we took a rope from the boat through the pulley and down onto the pod, so when the boat went off, the pod went up and we roped it in."

Hewetson and the others maneuvered themselves onto the tiny yellow pod, clinging to the side of the rig high above the seas. They shut the hatch and sat tight. If they hung on long enough, the calls for radio interviews would start streaming in on the satellite phone they had set up in the pod.

Suddenly, a powerful spray of water rained down on them. The workers were hosing the pod, like old cobwebs under the porch. They'd positioned a crane nearby, set to pull the pod off the rig, with a net underneath to catch the activists should they fall out.

Hewetson, realizing their plan, strapped on a rope and jumped out of the pod. "I tied the whole net in a big knot. It was just a useless bunch of rope then." Later, the oil company took more aggressive action. They sent some people down on ropes to stand on the pod's hatch, trapping Hewetson and the others inside. Then, with the activists trapped inside the pod, they craned the whole thing up onto the platform. They smashed open the hatch and grabbed the activists out. The police took over.

That was the last Hewetson saw of the Kevlar pod. Exhausted, out of fuel and batteries, the M V *Greenpeace* steamed home.

The oil industry said that the West's giant, self-reinforcing edifice built of black grease brought prosperity, pointing to the strong link between G N P growth and oil consumption. The more oil countries consumed, the more their G N P would shoot up. The more fuel workers consumed, with bigger and more fuel-intensive machines, the more productive they were. The correlation had been well-documented for decades.[29]

Critics wondered whether a rising G N P indicated genuine growth or a mere "swelling." Running up an $11 billion medical bill treating the childhood asthma epidemic triggered in part by trucks' diesel fumes added to the growth of the G N P, after all.[30] Such dilemmas were mostly brushed aside, most aggressively by those in the oil

industry. According to Rex Tillerson, the swaggering Texan vice president of ExxonMobil, the world would descend into poverty and insecurity if the oil industry were not allowed to hunt, track, and plunge their drills into every last corner of the earth. "It is clear that the discovery and growing use of hydrocarbons over the last century has contributed greatly to people's wellbeing," Tillerson said in February 2003. "Access to affordable and reliable energy supply remains essential to the continued progress, prosperity, and well being of the world's citizens." Regulations based on "misplaced" environmental concerns would waste the "limited resources" of private oil companies, restricting their ability to "provide the greatest good to society."[31]

Promoting variations on this argument, the U.S. government and the international lending institutions it dominates have ensured that the fossil-fuel economy doesn't end at Western borders, by affixing thick, oil-soaked strings to its loans to indebted developing countries. Between 1992 and 2002, American export credit agencies handed out over $30 billion for fossil-fuel projects to developing countries; the World Bank almost $25 billion. It is one hundred times more than the Bank doles out for renewable energy projects, according to one analysis.[32]

Ensuring that developing countries consume increasing quantities of oil is "crucial to the long-term growth of oil markets," the U.S. Department of Energy opined.[33] Carmakers and oil companies know that the next hot market for them is unlikely to be in the West, given that each licensed driver in the United States already owns a car. In 2000, automakers spent almost $10 billion advertising their cars outside the United States.[34] China, in particular, "offers huge potential for future growth" BP's annual report avowed.[35]

Today, congested, slum-ridden megacities such as Calcutta and Jakarta are rapidly vanquishing their well-trod footpaths and bike alleys for asphalt-paved roads for cars driven by the elite.[36] The effects can be seen from miles above the planet.

Ram Ramanathan, an atmospheric scientist, gazed out his airplane window, heading south from Mumbai, India. The thick brown city haze, from hundreds of millions of wood fires and flaming cow-dung patties, sped past the plane's oval windows as it climbed over the Indian Ocean. But almost a thousand miles later, as the plane glided over the open sea, the brown pall still hadn't lifted. "This is something big," he thought to himself.

Dust, ash, and smoke from Asia's poorly regulated industries have congealed into a giant dark cloud of smog, blocking out as much as 10 percent of India's sunlight. Ramanathan had flown through the two-mile-thick "Asian brown cloud," a permanent fixture now stretching thousands of miles over the skies of Asia.[37]

By 2020, the developing countries, led by China and India, are expected to consume almost 90 percent as much oil as the industrialized countries.[38] The growth in their demand for oil could outstrip oil demand growth in the West by almost two to one. It is only natural, according to the U.S. Department of Energy. Growing populations and burgeoning industrial economies in China, India, and the rest led to "rapidly rising consumer demand for transportation via cars and trucks powered with internal combustion engines."[39]