## INTRODUCTION

At 1:36 p.m. Moscow time on August 2, 2007, the robotic arm of a Russian mini-submarine planted a titanium replica of the Russian flag on the seabed of the North Pole, two and half miles below the ocean's surface. "Why did we place it?" asked Artur Chilingarov, the leader of the Russian expedition. "Well, any time a country wins something, it installs its flag." Explorers throughout history have planted their nations' banners at prominent locations such as the South Pole and the top of Mount Everest, he explained, so the Russian team—the first to reach the polar floor—was resolved to do likewise. "I'm proud the Russian flag is there," said Chilingarov. "If a hundred or a thousand years from now someone goes down to where we were, they will see the Russian flag."[1]

Chilingarov and his fellow crew members took substantial risks in piloting their vessel to the North Pole floor. Even in the middle of summer the polar ice cap is many feet thick, and the only way for the expedition's small submersible to enter the water—and to return to the surface when the dive had been completed—was to find a natural hole in the drifting ice sheet. When the team located an opening and began their descent, they could not know with any certainty that they would find a similar aperture on their return. Chilingarov admits that he feared for his life, rating his chances of survival at only 30 percent. But after planting the Russian flag and spending an hour and a half exploring the seabed, the team came back to the surface and, after some frantic searching, located the necessary opening in the ice. Nine hours after starting their dive, the expedition members returned to the (relative) safety of the icebreaker *Rossiya.*[2]

"I am not crazy to dive there again," Chilingarov said of the 2007 polar expedition. Still, he has not been able to conceal his pride in the achievement. "There have been almost 500 people in outer space; thirteen people have been on the Moon. But we were the first to travel under the North Pole."[3]

Chilingarov, who was awarded a Hero of Russia medal for his exploits, has spent most of his life exploring the Arctic and Antarctica on behalf of Soviet and Russian state agencies. From 1979 to 1992 he was part of the USSR State Committee of Hydrometeorology, becoming its deputy chairman in 1986; after the breakup of the Soviet Union, he served on various Russian scientific bodies and in 1993 was elected to the lower house of the Duma, the Russian parliament. Although the August 2007 expedition to the North Pole was privately organized and financed, Chilingarov has consistently affirmed that he was acting as a representative of the Russian state and its people. "Our main aim is to remind the whole world that Russia is a great polar and scientific research power," he said on the eve of the polar descent.[4]

But while national pride no doubt played a major role in his decision to plant a Russian flag on the polar seabed, Chilingarov has also made it clear that the expedition was driven in large part by pragmatic considerations. Long considered a frozen wasteland with little to attract human interest, the Arctic region is now believed to harbor vast deposits of oil, natural gas, and valuable minerals—resources that will become increasingly accessible as global warming melts the polar ice cap. Even during the Soviet era, Russian leaders insisted that the portion of the Arctic Ocean bordering Russia was part of its national territory; now that climate change is making this area (and its underground riches) ever more accessible, they are reasserting these claims. Indeed,

maintaining control over this vast region and extracting its material riches have been declared strategic national priorities. But to do so, Russia must first establish its rightful ownership of these offshore territories in accordance with international law—and it was to *this* end that Chilingarov descended to the floor of the North Pole.

Since 1982, the determination of offshore boundaries and territorial waters has been governed by the United Nations Convention on the Law of the Sea. The treaty allows each coastal nation to establish an "exclusive economic zone" (EEZ) extending two hundred nautical miles out from its shoreline, within which it is entitled to control the exploitation of all natural resources, including those lying beneath the ocean bottom. In addition, the convention allows a coastal state to claim ownership of its outer continental shelf, even if it extends beyond two hundred nautical miles. To acquire such rights, however, a claimant must provide scientific evidence to demonstrate that its continental shelf does, in fact, reach beyond its EEZ. For Russia to acquire legal control over a large stretch of the Arctic, therefore, it must show that its northern landmass extends to the North Pole. This, in turn, requires undersea mapping and the collection of geological samples—exactly the activities that Chilingarov's expedition was designed to undertake. "We must determine the border, the most northerly of the Russian shelf," he explained on national television.[5]

As it happens, the Chilingarov mission did not return with conclusive evidence that the polar seabed—a geological feature known as the Lomonosov Ridge—is an extension of the Russian landmass. Nevertheless, Moscow insists that the Lomonosov Ridge is indeed a part of Russia and says that it will undertake additional polar surveys to establish the legitimacy of its claim. The Russians have also made it clear that they will use force, if necessary, to protect their vital interests in the region. "We have immediately started the revision of our combat training programs for military units that may be deployed in the Arctic in case of a potential conflict," General Vladimir Shamanov, the head of the Defense Ministry's combat training board, said in June 2008.[6]

**REVERBERATIONS ELSEWHERE**

Chilingarov's expedition and Russia's subsequent moves to assert control over a vast slice of the Arctic produced alarm and indignation among leaders of the other Arctic nations, all of which have announced plans of their own to exploit the region's great hydrocarbon potential. Besides Russia, four nations—Canada, Greenland (administered by Denmark), Norway, and the United States—border the Arctic Ocean and claim significant chunks of its total expanse. And, like Russia, all four have recently taken steps to reinvigorate their claims.

The first to act was Canada, the country with the second largest Arctic coastline and long-standing Arctic interests. Scarcely had Chilingarov's mini-submarine stuck its flag into the polar seabed when Canada's foreign minister, Peter MacKay, issued a blistering response: "You can't go around the world and just plant flags and say, 'We're claiming this territory.' " [7] Of course, Chilingarov had not exactly laid claim to the North Pole based on the flag planting, but rather had argued that the surrounding seabed was an extension of Russian territory as defined by the UN convention. But this distinction did not prevent the Canadians from responding with an Arctic mission of their own. "The Russians sent a submarine to drop a small flag at the bottom of the ocean," a senior government official told the Associated Press six days after the Russian

descent. "We're sending our prime minister to reassert Canadian sovereignty."[8]

Shortly after this announcement, Prime Minister Stephen Harper left for one of Canada's northernmost settlements, the frigid hamlet of Resolute Bay, located on Cornwallis Island in the Canadian Arctic Archipelago. Speaking in a storage shed to protect him from the icy, howling winds, Harper announced a series of moves aimed at bolstering Canada's strategic presence in the Arctic region. Resolute Bay itself, he indicated, would become the home of a new Canadian Army training center for cold-weather operations. In addition, the government would establish a deepwater port for military and civilian use on Baffin Island, at the eastern end of the Northwest Passage between the Atlantic and Pacific Oceans.[9] "Today's announcements tell the world that Canada has a real, growing, long-term presence in the Arctic," Harper told reporters accompanying his visit.[10]

Russia's Arctic initiatives also prompted a vigorous response from Denmark, which exercises ultimate authority over Greenland. On August 11, 2007, while Prime Minister Harper was in Resolute Bay to reassert Canada's claims to the region, a Danish scientific expedition aboard the Swedish icebreaker *Oden* headed into far northern waters in an attempt to collect data showing that the Lomonosov Ridge was an extension of Greenland, rather than Russia. Although the Danish mission had been planned before Chilingarov began his expedition to the ocean floor, it was now portrayed as a necessary counter to Russia's territorial claims. "The preliminary investigations done so far are very promising," declared Helge Sander, Denmark's minister of science, technology, and innovation, as the *Oden* set sail. "There are things suggesting that Denmark could be given the North Pole."[11]

Norway, too, has paid increased attention to the Arctic region. In 2007, it began operation of the first liquefied natural gas facility above the Arctic Circle, at Hammerfest, 825 miles north of Oslo. This $7.7 billion facility converts gas from the offshore Snøhvit (Snow White) field in the Barents Sea into a supercooled liquid and transports it by ship to customers in the United States and southern Europe.[12] Buoyed by the success of their Snøhvit project, the Norwegians have announced plans to develop oil and natural gas fields in even more northerly waters of the Barents Sea, laying claim to large swaths of Arctic territory. To better defend its Arctic domains, moreover, Norway has relocated its joint military headquarters to Boda—550 miles north of Oslo and well above the Arctic Circle.

In the United States, the official response to Chilingarov's polar mission was muted, with little more than a sarcastic comment by a State Department representative. "I'm not sure of whether they've put a metal flag, a rubber flag, or a bed sheet on the ocean floor. Either way, it doesn't have any legal standing or effect on this claim," the department's deputy spokesman told reporters at the time.[13] Behind the scenes, however, there was considerable concern, leading to increased vigilance over Arctic affairs by the National Security Council. After devoting many months to a review of U.S. interests in the region, the council released a new strategic assessment of the Arctic in January 2009, shortly before President George W. Bush left office. Known officially as National Security Presidential Directive 66, this document now governs U.S. policy for the region. Among its key provisions is a call for intensified government effort to assert American sovereignty over a stretch of the continental shelf extending north from Alaska

toward the North Pole. The directive also promises federal support for efforts to undertake the extraction of oil and natural gas from Arctic reserves.[14]

**WHY THE ARCTIC? WHY NOW?**

Why this sudden burst of interest in the Arctic? For decades, the region elicited little interest from surrounding nations, except insofar as it played a role in the Armageddon scenarios of the U.S.-Soviet nuclear competition. (Most Soviet and American intercontinental missiles and long-range bombers were expected to fly over the polar region on the way to their intended targets, prompting the United States to establish radar stations and jet interceptor bases in Canada, Iceland, and Greenland.) After the Cold War, most military bases in the region were closed or downgraded, and, aside from the region's native Inuit inhabitants and an occasional fishing crew, few souls have been willing to brave the Arctic's frequent storms and bitterly cold weather to establish much of a presence there. But this historic neglect is now changing: the Arctic is attracting immense interest from the world's major energy firms, and the Snøhvit project in Norway is a harbinger of many more oil and gas facilities to come.

Driving all of this interest is the release of geological studies indicating that the Arctic may contain some of the world's largest untapped reserves of oil and natural gas. Until recently very little was known about the region's hydrocarbon potential, but a few years ago the U.S. Geological Survey undertook a systematic assessment of oil and gas reserves in the land and sea areas north of the Arctic Circle. The results, published in July 2008, were nothing short of astonishing: this region, which occupies a mere 6 percent of the earth's surface, was said to account for 22 percent of the "undiscovered, technically recoverable [oil and gas] resources in the world." This includes 13 percent of the world's undiscovered oil reserves and 30 percent of its undiscovered natural gas—together, the equivalent of 412 billion barrels of oil, or 56 times the current rate of U.S. annual petroleum consumption.[15]

This report, combined with similar studies commissioned by private firms, has triggered a rush by giant energy companies to acquire development rights in promising Arctic drilling zones. Most of this activity, at present, is concentrated in the Barents Sea, above Norway and northwestern Russia; the Chukchi Sea, between northwestern Alaska and eastern Siberia; and the Beaufort Sea, above northeastern Alaska and Canada's Northwest Territories. In the Barents, near Norway's Snøhvit project, the Russians are preparing to develop an even larger gas field, called Shtokman, in an area they control. In Alaska's portion of the Chukchi Sea, exploratory drilling is being planned by ConocoPhillips and Royal Dutch Shell; at a 2008 auction, these companies spent $660 million and $2.1 billion, respectively, for the right to develop certain areas of the territory. Farther east, in the Beaufort Sea, Shell is preparing to explore for oil in American waters while BP, ExxonMobil, and Imperial Oil of Canada will search in nearby Canadian waters.[16]

Many analysts believe that this is just the beginning of what has been termed an energy "gold rush" in the Arctic region. As the demand for energy rises and global warming makes the far north more accessible to survey and drilling vessels, additional fields are likely to be developed. With this in mind, giant energy firms are spending ever-increasing sums on Arctic exploration and acquiring especially hardened ships that can safely navigate ice-clogged seas.[17] "Despite

grueling conditions, interest in oil and gas reserves in the far north is heating up," Brian Baskin reported in the *Wall Street Journal*. "Virtually every major producer is looking to the Arctic sea floor as the next—some say last—great resource play."[18]

That the major energy firms are rushing to secure development rights in the Arctic is hardly surprising, given that they are always searching for new sources of supply as older fields become depleted. But the urgency of this northward drive, and the importance that these companies attach to it—as reflected in the vast sums that they are spending on complex and technologically challenging projects—is the product of something more profound. Until now, the energy industry has been able to tap into giant, easily exploited oil and gas reservoirs in relatively accessible locations, providing the world with cheap and abundant power. This vast profusion of affordable energy drove the great worldwide industrial expansion of the post-World War II era and allowed new economic dynamos to emerge in the developing world. But the era of readily accessible oil and gas has come to an end: from now on, vital energy supplies will have to be drawn from remote and forbidding locations, at a cost far exceeding anything experienced in the past. The world is entering an era of pervasive, unprecedented resource scarcity.

**NOT JUST THE ARCTIC, AND NOT JUST OIL**

The drive to acquire oil and gas leases in the Arctic region is by no means the only sign that we have entered a different age. The giant energy companies are also pursuing resource "plays" in northern Siberia, in the deep waters of the Atlantic, in remote corners of Africa, and in other previously avoided areas. And similarly forbidding, hard-to-access locations are increasingly becoming the primary focus for the mining industry and agricultural enterprises.

In Russia, for example, a major effort is now under way to develop oil and gas deposits off the east coast of Sakhalin, a large island in the Sea of Okhotsk in the North Pacific. Sakhalin Island is below the Arctic Circle, and so is spared the extreme temperatures of more northerly locations. Nevertheless, it is not an easy place to operate in. Temperatures in the winter often reach 40 degrees below zero, and the island lies in an area prone to typhoons. What's more, Sakhalin's offshore oil and gas platforms are often exposed to massive ice floes pushed toward the island by powerful currents in the Sea of Okhotsk. To withstand these floes, as well as the earthquakes that often rattle the area, the platforms have to be specially reinforced. And because an ice sheet surrounds much of Sakhalin in the winter, supply ships and oil tankers can reach the oil-production zone only during certain times of the year.[19] The island's vulnerability to severe weather was made especially evident in December 2011, when the *Kolskaya* oil rig capsized and sank in a fierce storm while being towed into a Sakhalin harbor, resulting in the death of most of the sixty-seven crewmen aboard.[20]

Equally daunting challenges face the developers of Brazil's new offshore oil discoveries, including the giant Tupi field in the deep waters of the South Atlantic. Known as "pre-salt" deposits because they lie buried beneath a thick layer of salt, Tupi and neighboring offshore fields are thought to hold as much as 100 billion barrels of oil, making them the largest untapped reservoir to be exploited since wells in the North Sea were brought online in the 1970s. But extracting oil from the pre-salt area will not be easy or inexpensive. The offshore deposits lie beneath 1.5 miles of water and another 2.5 miles of compressed salt, sand, and rock. New

drilling technologies will have to be developed to operate at these ocean depths and to penetrate the salt dome below. The subsalt reserves are also believed to contain high concentrations of natural gas, and the separation and handling of this gas will pose additional challenges.[21] Successful development of Tupi and other pre-salt fields will require hundreds of billions of dollars and many years of effort.

Innovative technologies are also the key to developing another kind of resource frontier now eagerly being explored by the major energy producers: dense rock formations that cannot be exploited by traditional drilling methods. Historically, most hydrocarbons have been produced from deposits in highly porous rocks such as sandstone, which readily release their oil and gas riches once a wellbore provides an opening to the surface. Less porous rocks, like shale, do not naturally allow trapped oil and gas to escape, so these formations must be artificially broken up by some means before the hydrocarbons can be extracted—an approach that had generally been considered too difficult and expensive to be practical. However, with the introduction of new techniques such as hydraulic fracturing, which uses high-pressure water blasts to crack the underground shale seams, major energy companies are increasingly looking to such "tight" rock formations as a promising new source of oil and gas. Likewise, engineers are finding new ways to extract usable fuel from the "tar sands" of Canada's Athabasca wilderness, turning the solid bitumen found there into synthetic crude oil. Some energy experts believe that new technologies such as these will help alleviate the future scarcity of conventionally produced oil and gas, but many scientists warn that the extraction of "unconventional" hydrocarbons will accelerate the rate of global warming and produce widespread environmental destruction.[22]

The harsh conditions that confront oil and gas corporations in Brazil, on Sakhalin, and in challenging geological formations are typical of the difficulties that the energy industry faces as it is increasingly forced to turn to reserves in remote, forbidding locations. And what is true of the oil and gas companies is also true of the mining industry. With many existing sources of key minerals facing exhaustion, giant mining firms such as BHP Billiton, Rio Tinto, and Freeport-McMoRan are obliged to search for new deposits in the same sort of distant, hazardous frontiers as their energy brethren. "Like oil, most of the easy-to-reach deposits of basic materials like copper, nickel, and gold have already been found and exploited," Patrick Barta noted in the *Wall Street Journal*. "That has left lower-grade deposits in remote, politically volatile countries that will cost more to develop than the mother lodes of yesteryear."[23]

Take copper, a vital component of electrical wiring, roofing, plumbing fixtures, and a host of other industrial products. The global consumption of copper has soared in recent years—largely thanks to an ongoing building boom in Asia—and every leading producer has struggled to keep up with demand. With many of the largest mines in Canada, Chile, and Indonesia having reached their peak levels of output (or having long since passed that peak), mining companies have been forced to look elsewhere for new sources of supply. For the most part, this means developing new deposits in remote and uninviting areas of Siberia, Mongolia, and the Arctic, or returning to war-torn areas in Africa where mines had been abandoned due to recurring violence.[24]

A similar picture prevails in the case of cobalt, nickel, titanium, and other vital minerals that are in heavy demand because of strong economic growth in Asia but, like copper, are largely derived

from mines that have passed their prime. To supplement the output of these aging mines, major producers are pursuing the same strategies employed for copper: seeking new deposits in frontier areas such as Mongolia, or plunging back into conflict-torn countries like the Democratic Republic of the Congo. Following the lead of Artur Chilingarov, some firms and governments are also looking at the ocean bottom as a source of valuable resources. In July 2011, a Chinese submersible, the *Jiaolong*, dove 16,500 feet below the surface of the Pacific Ocean—a near-record depth—in a test of deep-sea mining techniques. "China's economy is developing, and the central government finally realizes that it's not nearly enough only to develop mining on land," said Professor Wang Pinxian, head of the State Laboratory of Marine Geology at Shanghai Tongji University. "So this is a big step that we are starting to pay attention to exploring oceanic mineral exploration."[25] Whether on land or at sea, the outlook is the same: with existing sources of critical materials facing exhaustion, more and more of our essential supplies will have to come from places that are risky for reasons of geography, geology, politics, or some combination of all three.

And in the near future, the most precious natural resource of all—food—will also become scarce in many parts of the world. While the planet is currently capable of satisfying the basic nutritional requirements of the existing world population (although transportation difficulties and inequitable pricing often prevent food from reaching those in need), this capacity will come under threat in the decades ahead, as the population grows and climate change reduces the amount of rainfall in many areas. To guard against inevitable food shortages, government-backed agricultural firms in China, South Korea, Saudi Arabia, and the United Arab Emirates are already buying vast tracts of arable land in Africa and elsewhere to produce food for consumption at home. Many private investors and hedge funds in the West are pouring money into similar ventures. Such "land grabs" are being greeted with growing anxiety and hostility in the developing world, where land is scarce and hunger never absent. As the planet warms, the pursuit of these overseas food factories will no doubt become more intense—as will resistance from those who see them as a threat to their survival.

## THE RACE FOR WHAT'S LEFT

The pursuit of untapped oil and mineral reserves in remote and hazardous locations is part of a larger, more significant phenomenon: a concerted drive by governments and resource firms to gain control over whatever remains of the world's raw materials base. Government and corporate officials recognize that existing reserves are being depleted at a terrifying pace and will be largely exhausted in the not-too-distant future. The only way for countries to ensure an adequate future supply of these materials, and thereby keep their economies humming, is to acquire new, undeveloped reservoirs in those few locations that have not already been completely drained. This has produced a global drive to find and exploit the world's final resource reserves—a race for what's left.

At stake in this contest is the continuation of the Industrial Age. Ever since the onset of the Industrial Revolution, the major economies have consumed ever-increasing quantities of basic raw materials—wood, iron, copper, tin, and coal to begin with; oil, natural gas, uranium, titanium, and other specialized minerals in more recent times. Vast quantities of these materials

were extracted over the years to satisfy the needs of the major industrial powers, producing an incessant search for new sources of supply. As more and more countries have become industrialized, the demand for these materials has risen exponentially, so that current consumption rates are the highest in history. But many of the reserves that were developed in the previous century to meet the world's ravenous resource requirements have been substantially depleted, so the extractive industries' capacity to satisfy the needs of the existing industrial powers—let alone provide for the newly industrializing ones—is in serious doubt. Only by acquiring new sources of supply, wherever they might be found, can the industrialized nations continue to prosper.

The continued availability of energy and mineral supplies is also essential for political and military survival. No nation can maintain a robust military defense without a wide array of modern weapon systems, and most such systems—from warships to fighter jets—are fueled by oil. The U.S. military, with multiple overseas commitments and a significant combat presence in Southwest Asia, is especially dependent on petroleum, consuming as much oil every day as the entire nation of Sweden.[26] Other nations that seek to project military power beyond their immediate territory, such as Britain, China, France, and Russia, also require substantial petroleum supplies. Any nation that seeks to sustain a significant arms-making capability, moreover, must possess ensured supplies of iron, cobalt, nickel, titanium, and various specialty metals. And, of course, any country seeking to join the "nuclear club"—whether for political or for military reasons, or a combination of both—must have a reliable supply of uranium.

Eventually, perhaps, substitutes will be found for some of these materials. Intensive research is now under way, for example, to develop liquid fuels from cornstalks, prairie grass, wood chips, and other biological matter. Significant energy may also be provided in the future by hydrogen, a plentiful element incorporated into the molecular structure of water and many other substances. But these efforts will take a long time to mature, and it is not yet certain that they will be able to replace existing fuels on a one-for-one basis. Many of the new energy systems, moreover, require the use of resources that are themselves scarce or difficult to obtain. Any increase in biofuels production, for example, risks a reduction in global food output as more of the world's supply of farmland is devoted to producing energy crops. The wider use of hydrogen fuel cells will require increased supplies of the rare metal platinum to act as a chemical catalyst; likewise, most electrical cars and hybrids use batteries made in part of lithium, another rare metal. The development of these alternatives could, therefore, add further momentum to the race for what's left.

Under these circumstances, it is hardly surprising that the major industrial powers have embarked on an extended, calculated drive to gain control over the world's remaining preserves of vital natural resources. Governments and giant corporations—or the two acting in conjunction—have adopted ambitious plans to explore uncharted areas, pursue legal claims to disputed territories, acquire exploration and drilling rights in promising resource zones, introduce new technologies for extractive operations in extreme and hazardous environments, and develop military forces that can operate in these regions.

Some of the most elaborate of these plans concern the development of the Arctic region and

deep-offshore resource reserves. All five of the Arctic powers have devised detailed blueprints for the exploration and demarcation of their northern territories and the eventual exploitation of any hydrocarbon and mineral resources detected there. Other nations have adopted similar plans to exploit their offshore reserves (in the case of countries with a substantial coastal presence) or to forge alliances with other states that possess an abundance of such resources. The government of Brazil, for example, has adopted legislation establishing a new national agency, Petrosal, to oversee development of all new discoveries in the country's pre-salt basin in deep Atlantic waters and giving control over the fields to the state-owned company Petrobras.[27] Angola, Indonesia, and Nigeria are also proceeding with ambitious plans to develop their ultra-deep oil and natural gas reserves. China, too, seeks to develop its offshore fields and—knowing that it cannot hope to satisfy its ever-growing needs solely from domestic reserves—has embarked on a multibillion-dollar drive to acquire a significant stake in the offshore energy operations of other countries.[28]

The extent of these plans makes it clear that the race for what's left is not simply the product of many individual actions—all those forays into the Arctic, Siberia, and elsewhere—but rather something far more calculated and organized. National and corporate leaders are painfully aware that existing reserves of many vital resources are disappearing and that urgent action is needed to ensure that *their* country or *their* company will have sufficient supplies to survive. They are determined, therefore, to put in place whatever measures are needed in the coming decades to replace existing reservoirs with new sources of supply.

## INVADING THE LAST FRONTIERS

Human societies have, of course, been competing with one another for control over remote, undeveloped resource zones for a very long time. During the eighth and seventh centuries B.C., for example, the various Greek city-states established colonies throughout the Mediterranean basin and as far as the Black Sea to disperse excess population, acquire raw materials, and promote foreign trade.[29] The Romans kept expanding their empire as Italy's population grew and it became necessary to acquire grain and other foodstuffs from increasingly distant locations.[30] Later, in the fifteenth century, the European powers commenced a 400-year-long competition for control of overseas colonies in resource-rich areas of Africa, Asia, and the Americas. So the contemporary pursuit of vital materials in the Arctic, the deep seas, and on other resource frontiers can be viewed as part of a process that began thousands of years ago. But the race for what's left is not just a continuation of past behavior; rather, it represents a new stage in humanity's relentless hunt for critical materials—a drive without true precedents.

Several factors distinguish the current push from those of the past. To begin with, there are no other, as-yet-undetected frontiers lying beyond those now under assault. Until now, participants in the depletion of a particular resource zone could always comfort themselves with the thought that undeveloped lands lie somewhere else, still awaiting human exploitation. When the earliest American settlers exhausted the soils of New England and New York State, they moved West—first to Ohio and Indiana, then to the Great Plains, and eventually to the Pacific coast; some, in time, moved even farther afield, to Latin America and Hawaii. Likewise, the giant oil and mining companies have continuously extended their spheres of operation from traditional sites in Europe, North America, and Russia to remote and forbidding regions of Africa, Asia, and Latin

America. Today, however, there exist no untilled lands or untapped oil reserves awaiting fresh development. Virtually all accessible resource zones are now in production; except for the extreme areas such as the Arctic, the Congo, the ocean bottom, and unyielding rock formations, there is nowhere else to go.

For this reason, the invasion of the world's final frontiers has unique significance. What we expropriate from these areas represents all that remains of the planet's once abundant resource bounty. In all likelihood, we are looking at the last oil fields, the last uranium deposits, the last copper mines, and the last reserves of many other vital resources. These materials will not all disappear at once, of course, and some as-yet-undeveloped reserves may prove more prolific than expected. Gradually, though, we will see the complete disappearance of many key resources upon which modern industrial civilization has long relied.

And it is not just the most common resources like oil and copper that are likely to be exhausted in this final resource drive, but also the more exotic materials that are needed for specialty purposes, such as the chromium used in making stainless steel and the cobalt used in high-strength alloys. Demand is also outpacing the supply of the "rare earth elements," including dysprosium, lanthanum, neodymium, and terbium, used in making superconductors and hybrid car motors. Likewise, the growing popularity of "plug-in" hybrids and all-electric cars has increased the demand for lithium, an ultra-lightweight metal used in advanced battery designs. The remaining deposits of rare earths, lithium, and other exotic—but vital—materials will come under increasing assault as existing mines are depleted and demand rises around the world.

The current drive is also different from those of the past because of the sudden emergence of powerful new competitors in the global resource hunt. Until relatively recently, the pursuit of overseas energy and mineral resources was largely the prerogative of a few established industrial powers, led by the United States, Japan, Germany, Britain, and France. These countries dominated the global commodity markets and accounted for the bulk of foreign investment in large-scale resource ventures in Africa, Latin America, and the Middle East. But now, due to their impressive rates of economic growth, Asian dynamos such as China, India, South Korea, and Taiwan have become major resource consumers as well. China, for example, is now the world's leading consumer of coal, iron, copper, and aluminum ore, and the second leading consumer of petroleum. Like the older industrial powers, these new economic powerhouses are contributing to the rapid depletion of existing resource deposits and the drive to penetrate and exploit the planet's last undeveloped preserves.

This suggests that once the development of these final reserves begins, their depletion could occur very rapidly—producing a sharp contraction in the global supply of many critical resources. Under these circumstances, it is reasonable to assume that the various consuming powers will seek to gain control over as much as possible of what remains of these materials, producing an intense competitive struggle. This could lead to territorial disputes in areas where boundaries or ownership rights are contested—as is already evident in the Arctic region. In the past, such disputes have often erupted in armed combat, and there is no reason to believe that this will not happen in the future; indeed, the countries involved are already preparing for such combat by beefing up their capacity to operate in the Arctic and other contested resource zones,

such as the East and South China Seas. The pursuit of vital materials in remote and marginal areas will also pose extraordinary environmental challenges, and will lead to intensified clashes between outside powers and the indigenous peoples who occupy these areas.

Needless to say, all of this will be profoundly affected by the accelerated warming of the planet and associated climate effects—although not necessarily in ways that can be foreseen. It is possible that global warming will increase the availability of some resources, for instance by making the Arctic more accessible to oil and gas extraction; it is more likely, however, that it will constrict the supply of many key materials. Agriculture appears to be at particular risk: some key growing regions will suffer from a decline in annual precipitation, making the production of food increasingly precarious; others will receive more rain, but often in the form of intense downpours that result in floods and the loss of valuable cropland. In addition, rising sea levels will wash away many coastal farming areas, including important rice-growing lands in South and Southeast Asia. True, we have encountered climate effects like these before—but never on this scale, or with such far-reaching consequences.

Thus, while the current assault on remote resource frontiers bears some similarities to historical exploitation of undeveloped territories, it is in many important ways different from anything that has come before. Never have we seen the same combination of factors that confronts us today: a lack of any unexplored resource preserves beyond those now being eyed for development; the sudden emergence of rapacious new consumers; technical and environmental limitations on the exploitation of new deposits; and the devastating effects of climate change. In many cases, the commodities procured during this new round of extraction will represent the final supplies of their type. The race we are on today is the last of its kind that we are likely to undertake.