Environment:
TODAY & YESTERDAY

By Origins: Current Events in Historical Perspective
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THE OHIO STATE UNIVERSITY

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Water and Human Life

A lone plant grows in dry, cracked earth.
(Source: Flickr by DraconianRain)

Section 1

The West without Water: What Can Past Droughts Tell Us About Tomorrow?

EDITOR'S NOTE:

Almost as soon as European settlers arrived in California they began advertising the place as the American Garden of Eden. And just as quickly people realized it was a garden with a very precarious water supply. Currently, California is in the middle of a years-long drought and the water crisis is threatening the region's vital agricultural economy, not to mention the quality of life of its people, plants, and animals. This month B. Lynn Ingram, Professor of Geography and Earth & Planetary Science, examines how a deep historical account of California's water patterns can help us plan for the future

Published March 2015.

By B. LYNN INGRAM

The state of California is beginning its fourth year of a serious drought, with no end in sight.

The majority of water in the western United States is delivered by winter storms from the Pacific, and over the past year, those storms were largely blocked by an enormous ridge of high pressure. A relatively wet December has given way to the driest January on record, and currently over 90 percent of California is in severe to exceptional drought.

Lake Oroville, California, 2014. The level of water in this important storage reservoir is well below average, a visual reminder of the ongoing drought in the U.S. Southwest. (Source: California Dept. of Water Resources)

The southwestern states are also experiencing moderate to severe drought, and this comes on the heels of a very dry decade. This long drought has crept up on the region, partly because droughts encroach slowly and they lack the visual and visceral effects of other, more immediate natural disasters such as earthquakes, floods, or tsunamis.

Lake Powell, in 2009, showing a white calcium carbonate "bathtub ring" exposed after a decade of drought lowered the level of the reservoir to 60 percent of its capacity. (Source: U.S. Bureau of Reclamation)

Meteorologists define drought as an abnormally long period of insufficient rainfall adversely affecting growing or living conditions. But this bland definition belies the devastation wrought by these natural disasters. Drought can lead to failed crops, desiccated landscapes, wildfires, dehydrated livestock, and in severe cases, water wars, famine, and mass migration.

Although the situation in the West has not yet reached such epic proportions, the fear is that if it continues much longer, it could.

In California, reservoirs are currently at only 38 percent of capacity, and the snowpack is only 25 percent of normal for late January. Elsewhere in the Southwest, Lake Powell, the largest reservoir on the Colorado River, is at 44 percent of capacity.

The amount of water transported through irrigation systems to California's Central Valley—the most productive agricultural region in the world—has been reduced to only 20 percent of customary quantities, forcing farmers to deepen groundwater wells and drill new ones.

Over the past year, 410,000 acres have been fallowed in this vast agricultural region that provides 30 percent of all the produce grown in the United States and virtually all of the world's almonds, walnuts, and pistachios. As California dries up, food prices might well rise across the nation.

The question on everyone's mind is when will this dry period finally come to an end and rainfall return to normal—and just what is normal for the U.S. Southwest when it comes to rain?

And with a growing and more urban population and an ever-changing climate, will we ever be free from the threat of long dry periods, with their disruptive effects on food production and the plants and animals that rely on water to survive?

A glance into the history of the Southwest reminds us that the climate and rainfall patterns have varied tremendously over time,

with stretches of drought many decades longer than the one we are experiencing now.

Long dry stretches during the Medieval centuries (especially between 900 and 1350 CE) had dramatic effects on the native peoples of the Southwest (the ancestral Pueblo, Hohokam, and Sinagua), including civilizational collapse, violence, malnutrition, and forced social dislocation.

These earlier Americans are a warning to us.

The past 150 years, which we have used as our baseline for assumptions about rainfall patterns, water availability for agriculture, water laws, and infrastructure planning, may in fact be an unusually wet period.

Let's look at the past few hundred years first and then explore the region's climate in geological time.

Recent Droughts and the Arid Regions of the United States

John Wesley Powell stands as one of the most extraordinary scientists and explorers in America in the second half of the 19th century.

In 1869 he became the first white man to lead an expedition down the Colorado River and through the Grand Canyon, a feat all the more remarkable considering Powell had lost most of his right arm during the Civil War.

Ten years later, Powell published Report on the Lands of the Arid Regions of the United States, a careful assessment of the region's capacity to be developed.

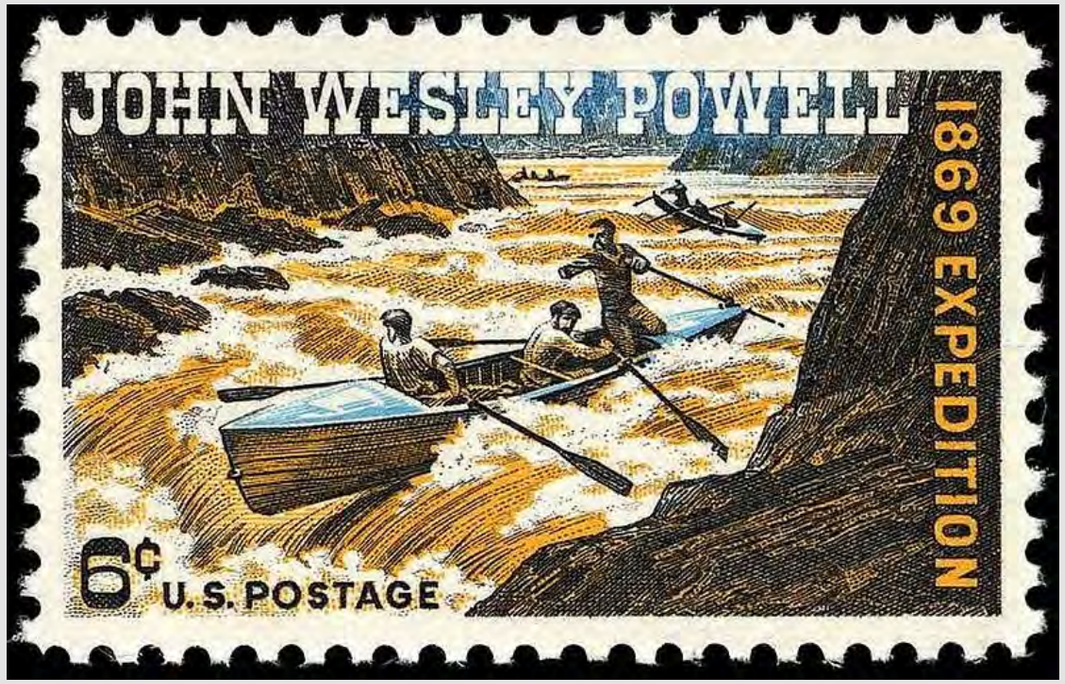
In it, Powell argued that very little of the West could sustain agriculture. In fact, his calculations suggested that even if all the water in western streams were harnessed, only a tiny fraction of the land could be irrigated.

Further, Powell believed that growth and development ought to be carefully planned and managed, and that boundaries drawn for new western states ought to follow watersheds to avoid inter-state fighting over precious water resources.

When Powell presented his findings to Congress, politicians howled. Powell found himself denounced by pro-development forces, including railroads and agricultural interests.

Prescient as Powell's study has proved to be, it was almost entirely ignored at the time.

Instead, those development boosters responded to Powell's data about the aridity of the west with a novel climatological theory: "Rain follows the plow." They insisted that agriculture could cause the rains to fall, so like magic the more acres brought under cultivation the more rain farmers would enjoy.



This stamp commemorates John Wesley Powell's 1869 expedition down the Colorado River. He remarked on the arid conditions of the west in his Report on the Land of the Arid Regions of the United States. (Source: U.S. Post Office)

The years surrounding the turn of the 20th century turned out to be unusually wet across much of the region. Hopeful pioneers continued to flock to the West, despite the visible signs of aridity.

They still do. The past century and a half in California and the West has been a period of steady population growth. And today the U.S. Southwest is the fastest-growing region in the United States (which itself is the world's fourth-fastest-growing nation).

The Dirty Thirties and Beyond

The relatively wet period of the late nineteenth and early twentieth centuries gave way to drought in the late 1920s with the start of the Dust Bowl—now considered to be the United States' worst climate tragedy.

The years between 1928 and 1939 were among the driest of the 20th century in the American West. This drought had particularly severe effects on California's developing agricultural industry that

Donner Lake, Sierra Nevada Range, California. (Source: photo by Lynn Ingram)

were only mitigated by the extensive pumping of groundwater that eventually caused the ground surface in California's Central Valley to drop by several feet.

In the 20th century, the single driest year (rivaling the 2013-2014 water year) was the drought of 1976-1977, extending across the entire state of California and into the Northwest, the Midwest, and the Canadian Prairie region north of Montana.

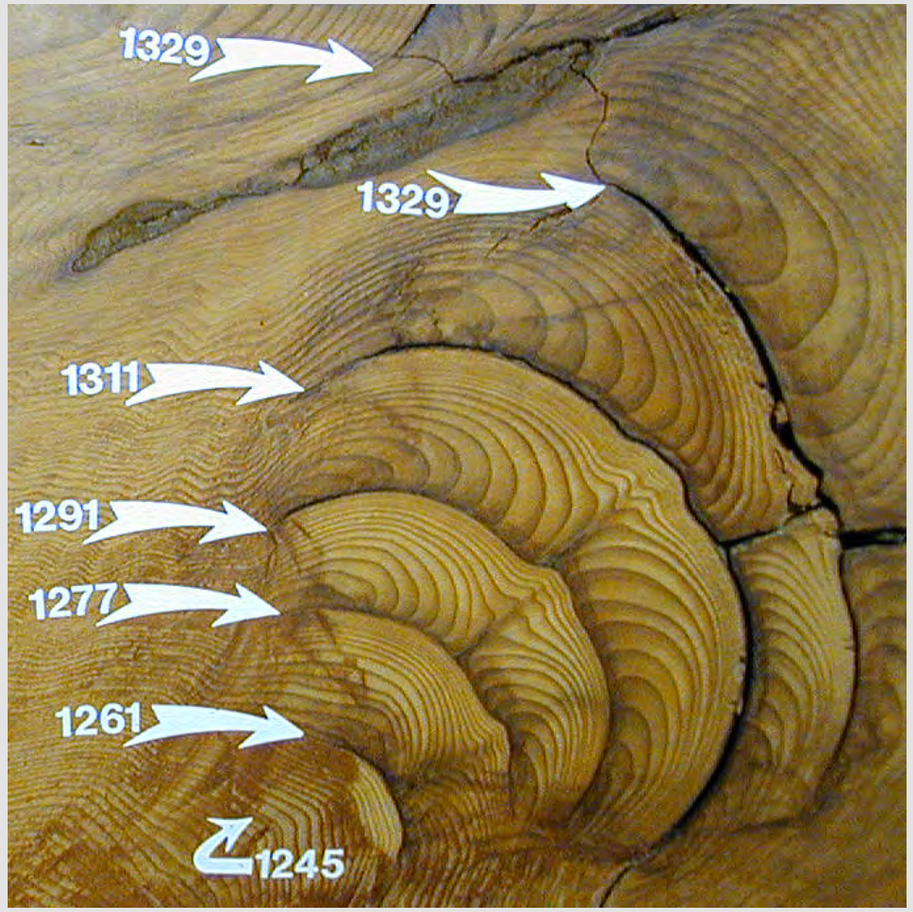
In California, precipitation levels dropped to less than a quarter of average. Reservoirs dropped to one-third their normal levels, and 7.5 million trees in the Sierra Nevada weakened by drought succumbed to insect related diseases, fueling massive wildfires. Snowfall was extremely sparse, forcing ski areas to close.

The following decade, another six-year drought occurred from 1987 to 1992, and while no single year was as severe as the drought of 1976-1977, the cumulative effects were ultimately more devastating. Annual precipitation attained only 50 percent of the 20th century average, with far-ranging impacts.

In the Sierra Nevada, water-stressed trees suffered widespread mortality from pine bark beetle infestations. Reduced stream flow caused major declines in fish populations, affecting commercial and recreational fisheries by lowering populations of Chinook salmon and striped bass.

By the fourth year of the drought, reservoir storage statewide was down 60 percent, causing a decline in hydroelectric power generation and the imposition of water restrictions including a decrease in agricultural water delivery by 75 percent.

Farmers relied more on groundwater, with private well owners deepening existing wells or drilling new ones. In the San Joaquin Valley, 11 million acre-feet more groundwater was extracted than could be replenished naturally, further lowering already low groundwater levels.



A cut section of a Giant Sequoia trunk from Tuolumne Grove, Yosemite National Park, California, showing AD dates of fires. (Source: Thomas Swetnam, Laboratory of Tree-Ring Research, University of Arizona)

Measuring Droughts over Geological Time

As bad and worrisome as these more recent historical droughts in California and the West were, they pale in comparison to events uncovered in the geological record.

In recent years, earth scientists have been discovering that the climate and weather in the West over the past 100 to 150 years represents only a narrow part of the full range of climate in the region.

By peering deeper into Earth's history—the past centuries and millennia—the frequency and magnitude of extreme climate events like drought can be better understood.

The evidence comes in various forms, such as mud from the bottom of lakes and ponds, microscopic organisms living in the oceans, bubbles frozen in glaciers, pencil-thin wood cores drilled from trees, and salts precipitating in dried-up lake bottoms.

One of the earliest records of past climate change comes from the rings of the long-lived Douglas fir. Trees are particularly effective recorders of climate because they respond every year to conditions of temperature and precipitation, responses recorded in the growth rings of their trunks.

In a landmark study during the early 1940s, a 600-year record of Colorado River flow using Douglas firs revealed several sustained periods of low water flow and these periods recurred with some regularity.

The reconstruction showed a particularly severe drought in the late 1500s, a drought lasting over a decade that has since shown up in multiple records from throughout the West.

These records also reveal that the driest single year over the past millennium (even drier than the parched 1976-1977 drought) occurred in 1580 CE. Trees across the West either had a narrow ring, or even a missing ring, that year.

Looking at an even broader picture, evidence from the past 10 millennia—a relatively warm era since the last Ice Age, which we call the Holocene—informs us that the severity of past extreme events (including droughts and floods) far exceeds those experienced over the past century and a half.

One of the longest dry periods for California and the West occurred during what is known as the mid-Holocene climatic optimum, a time when much of the earth experienced warmer than average conditions from about 4,500 to 7,500 years ago.

In the American West, there are numerous clues showing that this time period was drier than average for upwards of 1,400 years. These climate extremes caused significant human dislocations and forced native populations to migrate from the desert interiors of the West to the coastal regions.

The Tools for Uncovering Climate History

One of the most vivid clues for understanding the patterns of past drought in the West was revealed in Lake Tahoe toward the end of the Great Dust Bowl of the mid-1930s. At that time, Tahoe's water level dropped fourteen inches, exposing a mysterious clustering of tree stumps sticking up from the water's surface along the lake's southern shore.

Frances Malamud-Roam, B. Lynn Ingram, and Christina Brady coring a small oxbow lake in the Sacramento Valley, California. (Source: Anders Noren, University of Minnesota, LaCore curator)

These trees attracted the attention of Samuel Harding, an engineering Professor from the University of California, Berkeley. Harding discovered that the trees were large, with trunks as wide as three feet in diameter, and appeared to be firmly rooted in the lake bottom.

Harding reasoned that the trees had grown in this location for a long time to attain such sizes, and since they were now submerged in over twelve feet of water, he surmised that at some time in the past the lake level had been much lower.

After collecting cores through their trunks, he counted up to 150 rings, concluding that it was a dry spell of over a century that caused the lake level to drop, allowing the trees to grow along the former shoreline.

Harding had to wait two decades before he could date this drought, after the invention of radiocarbon dating in the 1950s. Radiocarbon measurements of the outermost rings of the tree stumps showed that these trees died approximately 4,800 years ago.

Decades later, more evidence emerged from Lake Tahoe during another of California's droughts in the late 1980s, when the lake's surface dropped again, exposing even more tree stumps.

This time, it was an archaeologist, Susan Lindstrom, who noticed the tops of trees sticking out of the water along Tahoe's southern shore. Donning scuba gear, Lindstrom was able to find fifteen

Sediment core taken by Frances Malamud-Roam and B. Lynn Ingram from beneath San Francisco Bay, California. (Source: photo taken by B. Lynn Ingram)

submerged tree stumps that had escaped Harding's attention, some measuring up to three and a half feet in diameter.

The radiocarbon dates from this much larger population of trees refined and extended the boundaries of the mid-Holocene drought, moving the beginning to as early as 6,290 years ago, and the ending to 4,840 years ago.

These stumps, located deeper in the lake, showed that the lake level had dropped by even more than Harding originally thought – by more than 20 feet. Lindstrom and other researchers have since located tree stumps in more places around the shores of Lake Tahoe and in other Sierran lakes.

Geologists have also discovered more evidence from sediment cores taken from beneath lakes revealing the wide extent of this drought—across California and the Great Basin.

The archaeological records show that native populations migrated from the inland desert regions to the California coast at this time, likely in search of water and other resources during this prolonged drought.

Another dry millennium began about 3,000 years after the mid-Holocene drought ended. Evidence for this prolonged drought was found throughout California and the West.

One study, conducted in my laboratory at UC Berkeley, examined sediments accumulating beneath the San Francisco Bay estuary. These sediments contain information about precipitation over the entire drainage basin of the Sacramento and San Joaquin Rivers —an area that covers 40 percent of California.

Rivers draining the Sierra Nevada Range and Central Valley flow through San Francisco Bay and out the Golden Gate to the Pacific Ocean. In the Bay, fresh river water meets and mixes with the incoming ocean water, producing a range of salinity: fresh at the Delta, saline in the Central bay near the Golden Gate, and brackish in between.

Mono Lake, showing calcium carbonate "tufa tower" formations that originally formed beneath the lake but are now exposed after the water level dropped. The eastern flank of the Sierra Nevada range is shown in the background. (Source: photo by D. J. DePaolo)

Organisms growing in the Bay record the salinity in their shells, which then sink to the bottom and are preserved in the sediments. We took sediment cores from beneath the Bay and analyzed the chemistry of the fossil shells, allowing us to reconstruct past salinity, and therefore past river flow.

These studies showed that droughts lasting over a decade occurred regularly over the past two millennia, at intervals of 50 to 90 years. The cores also revealed a period of high salinity that began about 1,700 years ago and ending about 700 years ago, suggesting another prolonged drought.

We conducted a related study with Professor Roger Byrne in the Geography Department at UC Berkeley, coring the tidal marshlands surrounding the bay to assess the impact of this drought on this ecosystem.

These marshes have grown up around the edges of San Francisco Bay for the past 5,000 years or so, forming peat. The marsh peats contain fossil plants and chemical evidence for past periods of wetter and drier conditions in the watershed.

A drought in the watershed, if prolonged and severe, can cause higher salinity downstream in the estuary as the inflow of fresh water drops. In response, salt-tolerant species in the marshes

Frances Malamud-Roam and Anders Noren coring marsh sediments adjacent to San Francisco Bay. (Source: photo taken by B. Lynn Ingram)

An ancient tree stump submerged in the West Walker River, eastern Sierra Nevada. (Source: photo courtesy of D. J. DePaolo)

expand further inland toward the Delta and the fresh water species retreat. Conversely, unusually wet winters generate fresher conditions in the estuary, leading to an expansion of freshwater-adapted species.

We analyzed the pollen and plant remains, carbon chemistry of the peats, and diatoms—the microscopic phytoplankton that grow in the marshes and produce tiny silica shells.

All of this evidence showed that the average freshwater inflow to San Francisco Bay was significantly lower than today's levels for a thousand years, between 1,750 and 750 years ago.

The peak of this low-inflow interval, with freshwater flows 40 percent below average levels, occurred approximately 900 to 1,200 years ago, during a time when global temperatures were high, known as the Medieval Warm Period.

Evidence for this drought was also discovered in an ancient lake situated east of the Sierra Nevada. Geography Professor Scott Stine analyzed the sedimentary sequences in Mono Lake, delineating patterns of alternately higher and lower lake levels for the past 4,000 years.

Mono Lake experienced an extended low stand that began about 1,600 years ago, dropping to an even lower level 700 to 1,200 years ago. During the 1980s drought, Stine also discovered large tree stumps submerged in Mono Lake.

Much like the tree stumps discovered in Lake Tahoe, these submerged trees indicated that at one time the lake was so small that its shoreline was several tens of feet lower than the present shoreline, when the trees now underwater could grow on dry ground. Stine went on to discover similar submerged tree stumps in lakes, marshes, and rivers throughout the central and southern Sierra Nevada Range.

By counting their growth rings, Stine determined that they had lived up to 160 years. Based on the amount the lake level dropped, he calculated that the average annual river flows in the region were only 40 to 60 percent of what they were in the late 20th century.

Radiocarbon dates of the outer growth layers of these tree stumps revealed that these trees clustered around two distinct periods, now known as the “Medieval Megadroughts”: CE 900 to 1100 and CE 1200 to 1350.

These records show that over half the American West suffered severe drought between CE 1021 and CE 1051, and from CE 1130-1170, CE1240-1265 and CE 1360-1382.

The warm and dry conditions of the Medieval period spawned larger and more frequent wildfires, as recorded in the trunks of Giant sequoias—the massive redwoods growing in about 75 distinct groves along the mid-elevations of the western Sierra Nevada. These spectacular trees can live up to 3,200 years or more, and have exceeded 250 feet in height and 35 feet in diameter.

Thomas Swetnam, the current Director of the Laboratory of Tree Ring Research at the University of Arizona, discovered that the trees carry scars on their annual growth rings that indicate past fires in the region.

Swetnam sampled giant sequoias from five groves between Yosemite National Park and Sequoia National Park, far enough apart that individual fires could not have spread from one grove to the next. He dated the trees using ring-width patterns, and recorded the fire scars contained within annual rings.

His analysis reveals that during the Medieval period, from 1,200 to 700 years ago, an average of thirty-six fires burned every century.

During the centuries preceding the Medieval period (from about 1,500 to 1,200 years ago) and immediately following it (from about 700 years ago to the current century), the fire frequency was substantially lower, with an average of 21 fires per century.

The Human Costs of Droughts Then and Now

The archaeological record suggests that the extended periods of drought in the Medieval era caused severe hardship for both coastal and inland peoples— particularly the ancestral Pueblo communities—as dwindling resources increased disease,

malnutrition, and warfare. Long inhabited sites were abandoned as the desperate populations wandered in search of new water sources.

Much of what archaeologists know about the ancestral Pueblo comes from pueblo and cliff dwellings from the four corners region, including Chaco Canyon in northwestern New Mexico, Mesa Verde in southwestern Colorado, and Canyon de Chelly in northeastern Arizona.

Chaco Canyon in New Mexico was the site of one of the most extensive of the ancestral Pueblo settlements. At its peak, during the 11th and early 12th centuries CE, Chaco Canyon had great pueblos the size of apartment blocks housing hundreds of residents in large, high-ceilinged rooms.

These settlements were supported by agriculture, allowing people to settle in one place year-round. Most of the farming depended on annual rains, supplemented by water from nearby streams and groundwater.

But over time, the climate became increasingly arid and unpredictable. The ancestral Pueblo farmers were forced to build an extensive system of diversion dams and canals, directing rainwater from the mesa tops to fields on the canyon floor, allowing them to expand the area of arable land.

The population in the four corners region swelled throughout the 11th and 12th centuries CE—but then collapsed.

Ancient pueblo cliff dwelling at Mesa Verde, southwestern Colorado. (Source: photo taken by B. Lynn Ingram)

Another ancient society, the Hohokam, lived in central Arizona near the confluence of Arizona's only three rivers, the Gila, Verde, and Salt. The Hohokam civilization thrived in central Arizona for a thousand years, building an extensive network of integrated canal systems, capable of transporting large volumes of water long distances.

At their peak, an estimated 40,000 Hohokam lived in Arizona, but they suddenly vanished in the mid-15th century.

Montezuma's Castle, a cliff dwelling occupied by the Sinagua, located just north of Camp Verde in central Arizona. (Source: photo by B. Lynn Ingram)

In northern Arizona, between Phoenix and Flagstaff, the Sinagua culture also thrived during this period. As the climate turned drier, they built cliff dwellings in central Arizona, suggesting that resources became scarce, forcing them to build fortified dwellings with hidden food storage areas. The Sinagua also disappeared about the same time as the Hohokam.

All of these societies were flourishing prior to a rather abrupt collapse. The archaeological record of the last decades of the ancestral Pueblo in Chaco Canyon abounds with signs of suffering.

Skeletal remains show signs of malnutrition, starvation and disease; life spans declined and infant mortality rates increased. Evidence of violence, possibly warfare, was found in mass graves containing bones penetrated with arrowheads and teeth marks, and skulls bearing the scars of scalping.

Piles of belongings were found, apparently left behind as the people abandoned their settlements and fled, some to live in fortified hideouts carved in the cliff faces, protecting their hoarded food from enemies.

The unusually dry climate of the Medieval period also appeared to have tested the endurance and coping strategies of even the well-adapted native populations in California.

The skeletal remains show that life in the interior of California was particularly difficult, as the drought severely reduced sources of food (nuts, plants, deer, and other game). Settlements along rivers were abandoned, and trade between inland and coastal groups broke down. As water supplies dried up, conflicts – even battles – between groups arose over territory and food and water resources.

The Watery Lessons of the Past

The "Medieval Drought" serves as a model for what can happen in the West. It also provides an important impetus for water sustainability planning. And the hardships suffered by the first human inhabitants in the West provide important lessons.

For instance, during extended periods of abundant moisture, some societies experienced rapid population growth, leaving them vulnerable to collapse when the climate inevitably turned dry again.

Modern societies in the West have followed a similar path over the past century— after a century of fairly abundant moisture, the population in this region has exploded (and become more urbanized).

Modern engineering has allowed the exploitation of all available water sources for human use, and western water policy has favored water development for power, cities, and farms over sustainability of the environment and ecosystems.

These policies have allowed populations to grow to the limit that this region can support, leaving us vulnerable during extended drier conditions.

The longest six-year droughts experienced by the West over the past century are meager by comparison, despite the extreme hardship they brought to the region.

In fact, in the context of the longer-term climate history, the 20th century actually stands out as one of the wettest over the past 1,300 years, yet the droughts of the mid-1920s, 1977 and the late 1980s caused immense hardship for our society, based as it is upon heavy water usage.

In addition, future changes in the global climate will interact with the natural cycles of drought in California and the West in ways that are difficult to predict. Climate models predict that warming will likely make the extreme events, particularly floods and droughts, even larger and more frequent.

Some of these impacts have already begun. Over the past two decades, warming and an earlier start of the spring season have caused forest fires to become more frequent and intense.

Drought during the late 1920s gave way to the Dust Bowl, one of the United States' worst climate tragedies. (Source: Wikimedia Commons, Library of Congress)

A warmer climate will also bring less precipitation that falls as snow. The American West depends on snow-bearing winter storms for a natural water reservoir. This snow begins melting in the late spring, and continues into the summer, filling streams, lakes, and reservoirs that sustain natural ecosystems throughout the dry summer months.

The snow pack supports cities and irrigated agriculture, providing up to 80 percent of the year's water supply across the West. As the region warms, the snow that does fall will melt faster and earlier in the spring, rather than melting during the late spring and summer, when it is so critically needed.

Folsom Lake, 2014. A bone-dry boat dock. Photo taken from California Department of Water Resources' album: "What Drought Looks Like." (Source: California Department of Water Resources)

Folsom Lake, from California Department of Water Resources' album: "What Drought Looks Like." (Source: California Department of Water Resources)

The message of past climates is that the range of "normal" climate is enormous—and we have experienced only a relatively benign portion of it in recent history. The region's climate over the past decade has been dry when compared to the 20th century average, suggesting a return to a drier period.

This past year was also the warmest on record in the American West, and the ten hottest years on record occurred since 1997. The position of inhabitants of the West is precarious now and growing more so.

As we continue with an unsustainable pattern of water use, we become more vulnerable each year to a future we cannot control. It is time for policy makers in the West to begin taking action toward preparing for drier conditions and decreased water availability. ◆

Suggested Reading

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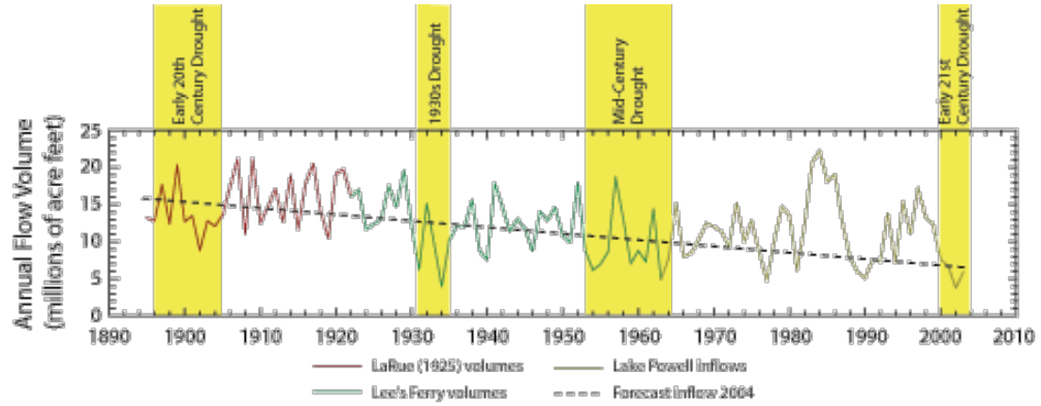
Maps and Charts

California Central Valley Project

A map of California's current Central Valley Project features. (Source: California Department of Water Resources)

Colorado River Flow Graph



Annual flow volume of the Colorado River. (Source: Wikipedia.org)

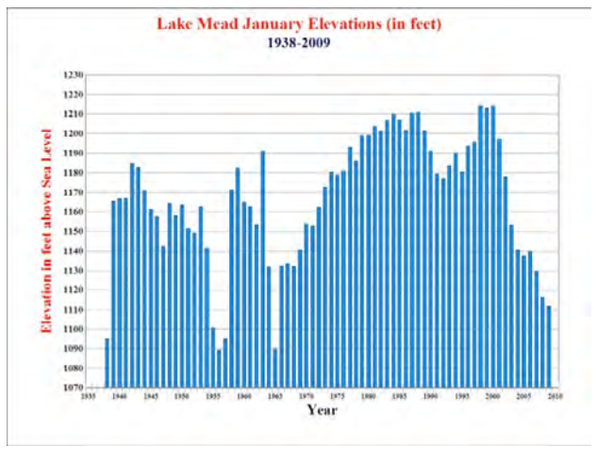
Map of Sacramento River Watershed.

(Source: Wikipedia.org)

A map of the Colorado River Basin

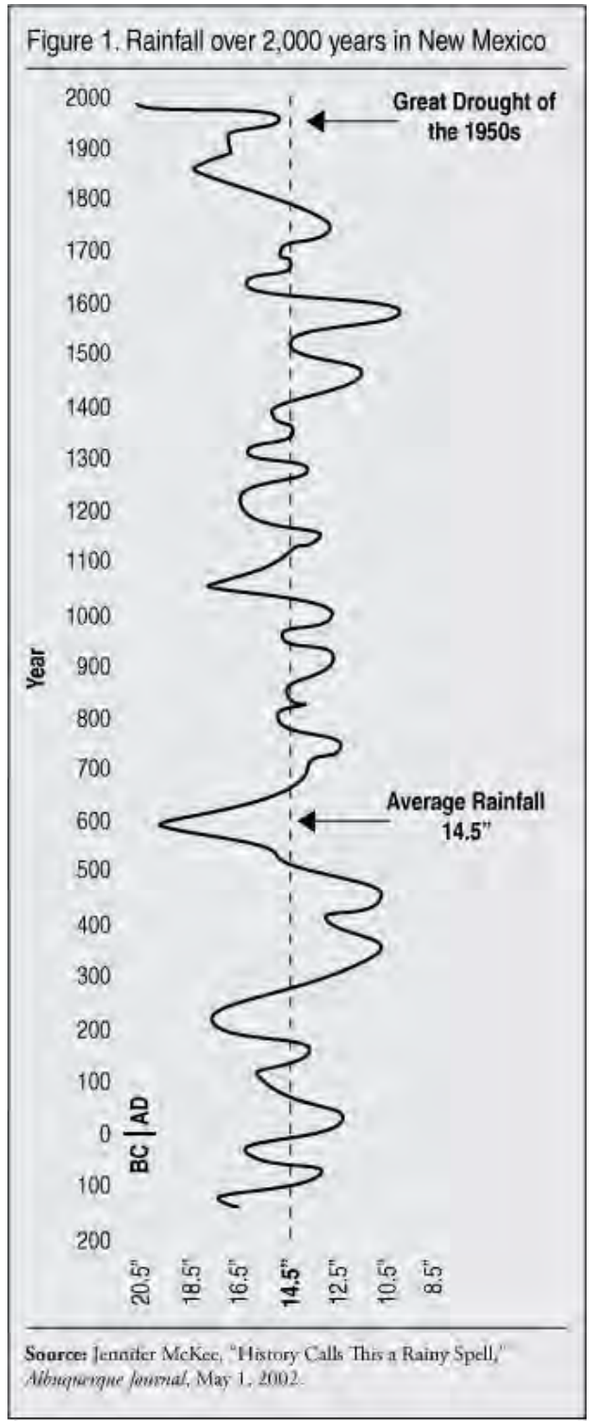
(Source: Wikipedia.org)

Annual flow volume of the Colorado River. (



(Source: Nebraska Weather Photos)

New Mexico Rainfall



(Source: Center for Immigration Studies)

Great Basin

A Map of the multi-state Great Basin. (Source: Kmusser, CC BY-SA 3.0)

Additional Images

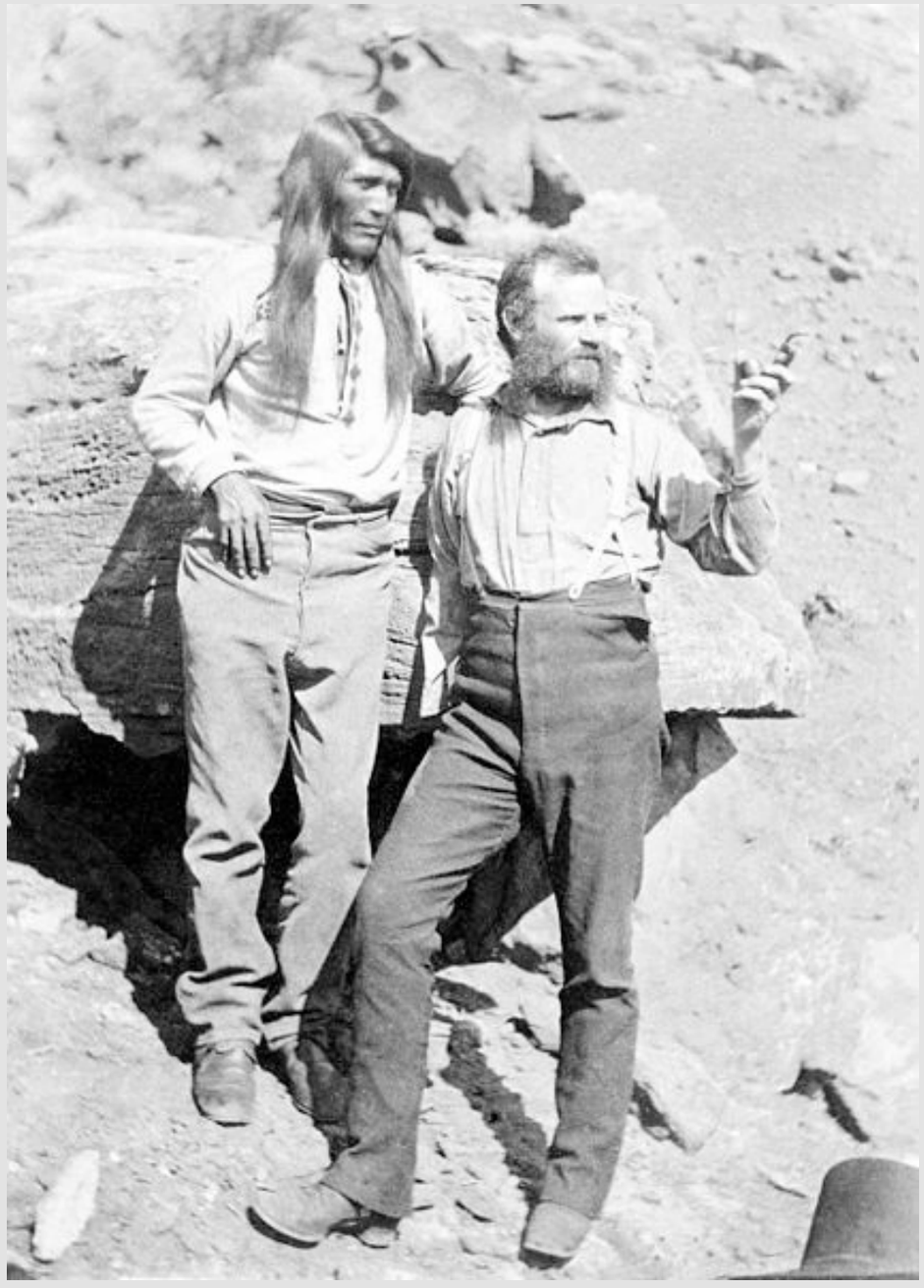
Shasta Lake, 1965

A photo of Shasta Lake and Shasta Dam (part of the California's Central Valley Project), with the lake at its fullest in 1965. (Source: Wikipedia)

The Colorado River

A study during the early 1940s produced a 600-year record of Colorado River flow and revealed several sustained periods of low water flow. (Source: Wikipedia)

John Wesley Powell



In 1869, John Powell became the first white man to lead an expedition down the Colorado River and through the Grand Canyon. Here he stands with a Paiute Native American during the Colorado expedition circa 1871. (Source: U.S. National Park Service)

Lake Powell, 2006

In the Southwestern United States, Lake Powell, the largest reservoir on the Colorado River, is at 44 percent of capacity. (Source: Wikipedia)

The beautiful Emerald Bay of Lake Tahoe.

The beautiful Emerald Bay of Lake Tahoe. (Source: Wikipedia)

Marsh Sediment, San Francisco Bay

Frances Malamud-Roam and Anders Noren coring marsh sediments adjacent to San Francisco Bay. (Source: B. Lynn Ingram)

Montezuma Well

The Montezuma well of the Sinagua is listed in the National Register of Historic Places. (Source: Wikipedia)

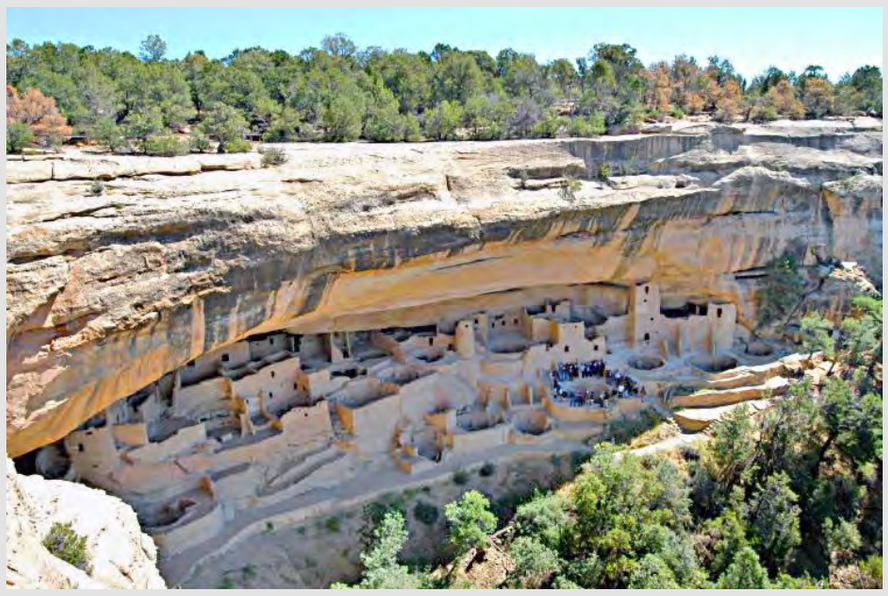
Oroville Lake

Oroville Lake, from California Department of Water Resources' album: "What Drought Looks Like." (Source: California Department of Water Resources)

California's "Save Our Water" Program attempts to stave off effects of potential drought.

(Source: State of California)

Cliff Palace



The famed Cliff Palace housed the ancient Pueblo Peoples of Mesa Verde. (Source: Wikipedia)

Dust Bowl, 1930s

Drought during the late 1920s gave way to the Dust Bowl, one of the United States' worst climate tragedies. A dust storm approaches a town in Stratford, Texas in this photograph. (Source: Wikipedia)

Hohokam

This hiking trail covers part of a canal the Southwestern Hohokam built in 700 CE. The trail leads to Indian Mesa. (Source: Wikipedia)

Section 2

Baptized in the Jordan: Restoring a Holy River

EDITOR'S NOTE:

As the site of the baptism of Jesus Christ, the Jordan River is the source of all holy water in Christianity and has for centuries attracted pilgrims from across the world. Over the last 60 years, however, the river has fallen victim to the ongoing regional conflict and been reduced to a polluted muddy stream. Francesca de Châtel travels to the banks of the most holy and contested transboundary river in the Middle East and looks at the causes of the Jordan River's demise and what is being done to restore it.

Published September 2014.

By FRANCESCA DE CHÂTEL

Dressed in white gowns, the group of Russian pilgrims gathered silently by the steps that led into the river. The priest, a tall figure with shoulder-length hair and a beard, intoned a hymn and the pilgrims joined in, bowing their heads in prayer. Barely five meters away on the opposite shore, two Jordanian soldiers looked on from the shelter of a reed-covered platform – no visitors had come to visit their side of the river yet that day.

As the pilgrims sang, the priest slowly descended into the muddy water, which reached only to his thighs, so that he almost had to lie down to immerse himself fully. He emerged with closed eyes, gasping for breath. The women, their heads covered, lined up on the steps, some holding young children by the hand.

Baptism at Qasr al Yehud, West Bank. (Source: Francesca de Châtel, 2013)

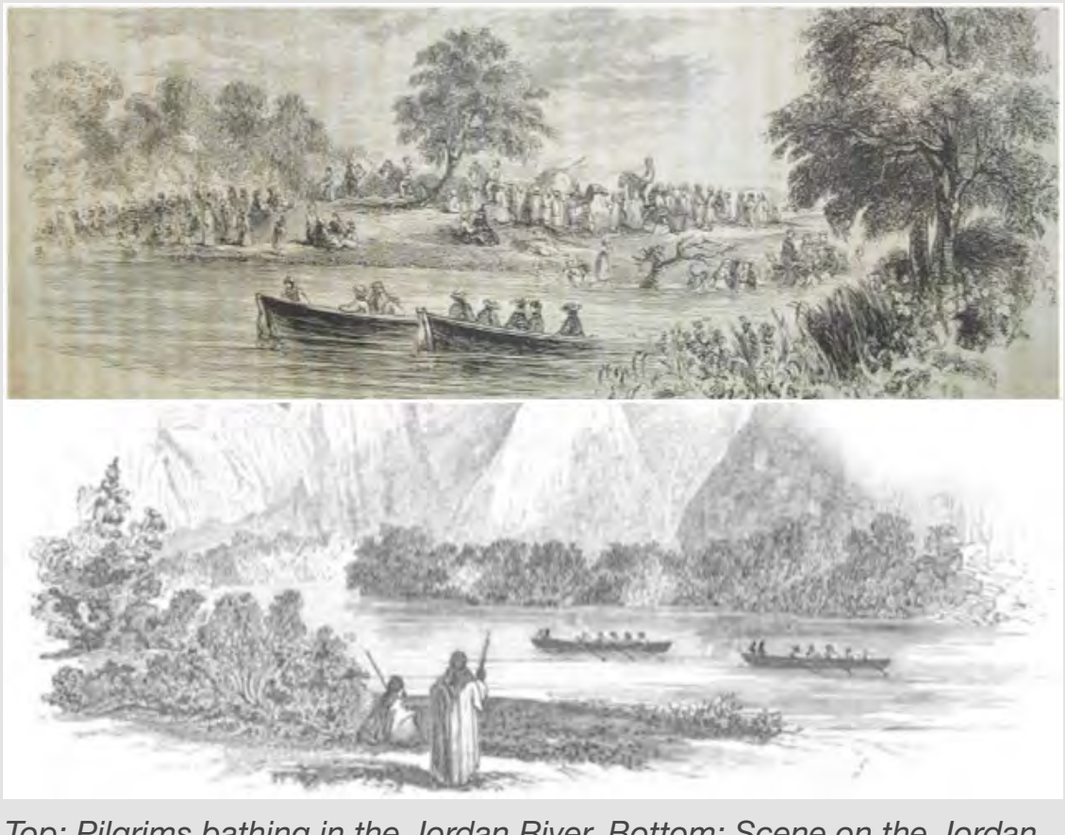
One by one, they descended into the water, knelt in front of the priest and crossed themselves before he placed his hand on their head and immersed them in the water. Three times – in the name of the Father, the Son, and the Holy Spirit.

Meanwhile, a group of young Americans sat in the shade of some palm trees on the bank and listened to their guide, an American woman wearing a safari hat and khaki desert trousers, who explained the significance of the holy Jordan River.

“You can see that the river is quite muddy,” she said as she pointed to the timid murky flow, “but it’s actually not dirty, because there’s so many bends in the river.” Her audience nodded and one girl complained it was too hot.

The Russian baptism ritual completed, the pilgrims emerged from the water and took photos of one another by the river, while three young boys started a water fight in a corner of the baptismal pool. Their mothers scolded them loudly and dragged them off to the showers. Half an hour later, after a visit to the gift shop, both groups were getting back on the Israeli tourist buses, off to the next stop on their day tour of biblical sites.

As the boundary of the Holy Land and the site of the baptism of Jesus Christ, the Jordan River is the source of all holy water in Christianity. For centuries, pilgrims have travelled long distances to immerse themselves in the river and even today nearly a million



Top: Pilgrims bathing in the Jordan River. Bottom: Scene on the Jordan River. (Source: Lynch, 1853)

visitors annually flock to the three baptism sites in Israel, Jordan, and the Palestinian West Bank to follow in the footsteps of Christ.

Over the past century, however, the Jordan River has been drawn deep into the Arab-Israeli conflict.

Once a meandering river full of rapids and cascades, the Jordan has been extensively developed since the 1950s, with dams, diversion canals, and large-scale irrigation projects on the river itself, its tributaries, and its headwaters. As a result, flow has been reduced to about a tenth of its historic level. And water

quality has sharply deteriorated, with raw sewage and agricultural runoff polluting the remaining water.

The Jordan River is both a cause of conflict and tension as well as a potential source of regional cooperation. It became one of the most contested transboundary rivers in the Middle East with the creation of Israel in 1948, and, since 1967, a heavily militarized political border.

In the face of this highly complex situation, the regional NGO Friends of the Earth Middle East (FoEME) is nonetheless working to revive the Jordan River, restoring the basin as a single interconnected ecosystem and a shared cultural heritage site that transcends political boundaries.

The Jordan River has since biblical times been imbued with powerful symbolic meanings: it is a boundary and a crossing point, a metaphor for spiritual rebirth and salvation, and a source of holy water.

But the river's symbolic significance became even more layered in the 20th century. As the physical river and its tributaries underwent far-reaching infrastructural changes, the Jordan River took up new meanings as a geopolitical border, a contested transboundary watercourse, a threatened ecosystem, and a tightly regulated water resource system.

The strength of these different geopolitical, hydrological, environmental, and religious narratives is sharply crystallized on the Lower Jordan River where holiness, pollution, hydropolitics, and national boundaries collide.

Source of Holy Water and Pilgrimage Site

The Jordan River plays an important role in the Old Testament as the border of the land that God gives to the Israelites. In the New Testament, John's baptism of Jesus forms a seminal moment in the life of Christ and marks a defining event in the Christian Church.

The baptism also altered the spiritual status of the water of the Jordan River.

Early Christian writers asserted that Christ's immersion in the Jordan sanctified the river's water, which in turn made all water holy. The Jordan was seen as the prototypical "river of life," but also the site of a divine manifestation of God, for just as water had been the primeval element that witnessed God's creation, the Jordan had witnessed the beginning of the Gospels.

The site where John baptized Jesus in the Jordan River became an important pilgrimage site from the 4th century CE.

Several writers recorded their visits here, including the 6th-century geographer Theodosius who described a marble column topped by an iron cross that had been erected at the place where Jesus was thought to have been baptized. He also wrote about the Church of St. John the Baptist, built by the Emperor

The baptism of Christ as depicted in the Arian Baptistery in Ravenna, Italy. (Source: Holly Hayes, 2008 Creative Commons)

Anastasius, which "stands on great vaults which are high enough for the times when the Jordan is in flood."

The sick and disabled also came to the Jordan for healing, as Jacinthus the Presbyter related in the late 11th century: "On the feast of the Epiphany cripples and sick people come and, using the rope to steady themselves, go down to dip themselves in the water: women who are barren also come here."

For those who were too sick to make the journey, water could also be drawn from the river and brought to them.

Thus the Russian Princess Euphrosine of Polatsk, who had come to Jerusalem to die in the 12th century, was unable to travel to the Jordan but was given a bottle of holy water by an acquaintance, "which she received with joy and gratitude, drinking it and spreading it over her body to wash away the sins of the past."

By the late Middle Ages, the Jordan was venerated almost exclusively as a relic of Jesus Christ, possessing powerful spiritual forces. A late-13th-century guidebook gave just one reason for immersion in the river: "these are the waters which came into contact with the body of Christ, our Redeemer."

Russian pilgrims at the Jordan. (Source: Catalogue of photographs made by the American Colony 1898-1914)

Writing in 1483, Felix Faber described how several knights of his party had jumped into the Jordan fully clothed, convinced that their clothes would become impenetrable to enemy weapons.

Others dipped bells in the river and believed that ringing them would stave off lightning and thunder.

The 17th-century English cleric Henry Maundrell described how pilgrims also cut branches off the reeds on the riverbanks, while later accounts by 19th-century Russian travelers described pilgrims taking bottles of holy water and burial shrouds dipped in the river home with them.

A Divided River and How We Think about It

From its sources on the slopes of Mount Hermon, the Jordan River winds its way through the Jordan River Valley over a distance of about 225 km to discharge into the Dead Sea, the lowest point on earth at –422 m.

The river's headwaters, the Dan, Hasbani, and Banias, originate in Israel, Lebanon, and the Israeli-occupied Golan Heights respectively, and meet inside Israel to form the Upper Jordan River, which flows into Lake Tiberias (also known as Lake Kinneret or the Sea of Galilee), Israel's largest freshwater reservoir that supplies approximately one third of the country's annual water requirements.

South of Lake Tiberias, the Lower Jordan River covers a distance of 143 km to the Dead Sea. Historically, this part of the river was fed by water from Lake Tiberias, the Yarmouk River (the Jordan River's largest tributary) and several seasonal wadis. Today, water levels in this part of the river have been sharply reduced due to large-scale regulation and diversion works in Israel, Jordan, and Syria.

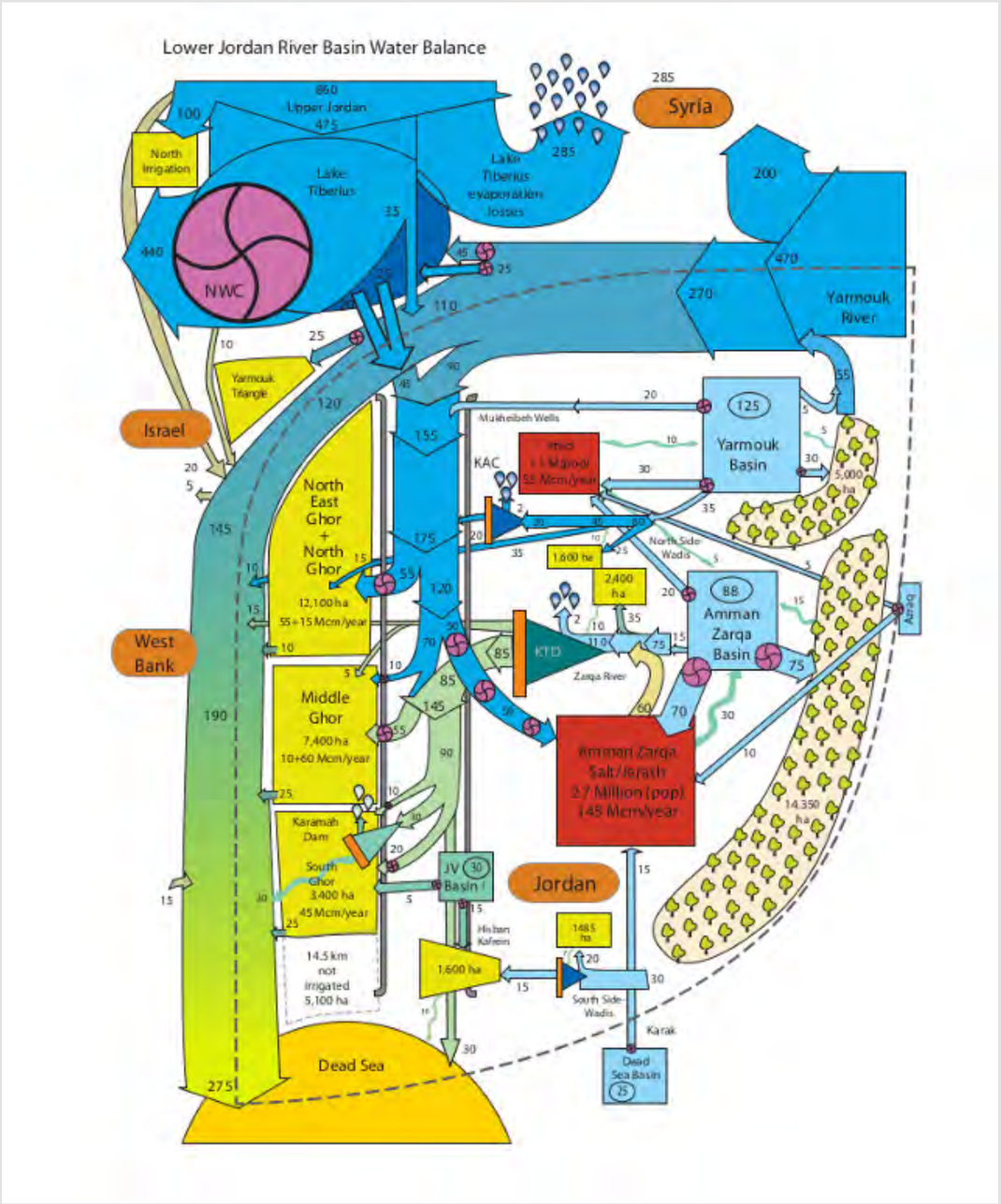
By 2009, the Lower Jordan River's historic annual flow of 1,300 million cubic meters (MCM) had been reduced to an estimated 20-30 MCM. Moreover, most of the fresh water in this part of the river has been replaced with saline flows, water from fishponds, sewage, and agricultural runoff.

The 20th-century transformation of the Jordan River has been extensively analyzed from the perspective of international relations, international law, politics, geography, history, hydrology, ecology, and social studies. It has been used as a textbook example of the disputed transboundary watercourse in a water-scarce region par excellence, caught in the middle of a protracted political conflict and subject to multilateral power struggles.

This extensive body of research and analysis has further fragmented and abstracted perceptions of the Jordan.

Thus the river is now commonly described and analyzed as a composite of separate units: the Upper Jordan River, Lake Tiberias/Lake Kinneret, the Yarmouk River and the Lower Jordan River. The drastic infrastructural interventions along the river, which have fundamentally altered water flow, water quality and local ecosystems, are schematically represented in conceptual flow diagrams.

Historically described as “the most crooked river in the world,” “sometimes dashing along in rapids by the base of a mountain, sometimes flowing between low banks,” the river is now a system that has been transformed into a series of contiguous and artificially controlled water bodies.



Lower Jordan River Water Balance 1950-1975. (Source: Courcier et al., 2005)

Even the water itself has been dissected, quantified, and qualified: separating the saline from the fresh; diverting drinking water away from the valley and pumping raw sewage back into the river; extracting irrigation water from side wadis, tributaries, and dam reservoirs; and releasing contaminated return flows back into the river.

A Geopolitical and Religious Border

Despite the extensive infrastructural developments that have led to a dramatic drop in water levels and deterioration in water quality, public awareness of the slow demise of the Lower Jordan remains low. The main reason for this void is that the river itself has been largely inaccessible and thus invisible since 1967.

As the geopolitical border between Jordan to the east and Israel and the Palestinian West Bank to the west, the Lower Jordan River remains a largely closed – and in many places mined – military zone that can only be reached at a few points along its course.

The only place where Jordanians can visit the river is at the Al Maghtas Baptism Site just north of the Dead Sea, a location that

has only been accessible since Jordan signed the Peace Treaty with Israel in 1994.

Israelis have no access south of the Yarmouk River, while Palestinians can only access the river at the Israeli-controlled baptism site in the West Bank, Qasr al Yehud.

The fact that the physical river has been largely out of sight since 1967 further strengthens its conceptual representations and increases the disconnect between the physical river and its mythical image.

This same disconnect exists in the religious realm.

The reality of a diminished, polluted river does not appear to affect the spiritual value of the water. The three baptism locations – the Baptism Site/Al Maghtas in Jordan, Qasr al Yehud in the West Bank, and the Yardenit Baptismal Site in Israel – present themselves as religious places focused on biblical history and archaeological remains, and gloss over the many other narratives that play out along the river.

Yet the region's recent history flows just beneath the surface, cluttering the mythical narrative of the Jordan River as a source of spiritual cleansing and renewal with the starkly utilitarian and political narratives of modernity that materialize in the form of dams, sewage flows, land mines, and security checkpoints.

Just north of the Dead Sea, the Al Maghtas/Baptism Site in Jordan and the Israeli-operated Qasr al Yehud site in the West Bank lie just a few meters apart on the two banks of the river with an invisible border running between them. Both sites argue that theirs is the "authentic" site of Jesus' baptism, presenting biblical, archaeological and historical evidence to corroborate their claim.

As one of the earliest Christian pilgrimage sites, the Jordanian Al Maghtas/Baptism Site was largely abandoned after World War I

The Lower Jordan River from Al Maghtas/The Baptism Site in Jordan looking at Qasr al Yehud in the West Bank. (Source: Francesca de Châtel, 2013)

and became part of an inaccessible military zone after the 1967 Six-Day War.

After Israel and Jordan signed a peace treaty in 1994, the area was de-mined and “rediscovered.”

The remnants of a Byzantine chapel built on the Jordan River, on the site where Jesus is said to have been baptized, Al Maghtas/The Baptism Site, Jordan. (Source: Francesca de Châtel, 2013)

Extensive archaeological work uncovered a series of churches, monasteries and other remains, including the cave where John the Baptist retreated in the desert, and the church described by Theodosius in the 6th century. Together with further textual references, these archaeological finds have led the Jordanian authorities to declare this to be the authentic baptism site.

The Jordanian claim has been further strengthened by a series of “letters of authentication” from world religious leaders, and visits by three popes and numerous monarchs, heads of state, and other dignitaries.

Moreover, the Jordanian government’s move to donate national land for the establishment of 12 churches of different denominations on the site adds a layer of modern mythology to the layers of biblical, archaeological, and historical mythology.

Just like its transboundary neighbor, the Qasr al Yehud site in the Israeli-occupied West Bank uses archaeological remains and

The Madaba Map, Madaba, Jordan. (Source: Soon Kim, 2013. (Creative Commons)

historic accounts to prove it is the authentic site of Jesus' baptism. It refers to the 6th-century Madaba Map, which places "Bethabara" (Bethany Beyond the Jordan) and the church of John the Baptist west of the Jordan River.

Pilgrims at Qasr al Yehud, West Bank. (Source: Francesca de Châtel, 2013)

While the site at Qasr al Yehud could in the future become a Palestinian site as part of a peace settlement, for the time being it remains firmly under Israeli control, as it has been since 1967. Like Al Maghtas in Jordan, the area around Qasr al Yehud was affected by the regional conflict and became an inaccessible military zone after 1967, cordoned off by a security fence and surrounded by minefields.

After 1980, limited access was granted to local church communities who came to celebrate Epiphany and Easter. During the rest of the year, pilgrims could only visit the site by appointment with a military escort.

However, after the papal visit in 2000, Israel decided to refurbish the site, a project which was jointly implemented by the Israeli Nature and Parks Authority and the Civil Administration, the Israeli body that governs the West Bank. Funding for the project came from the Israeli Ministry of Tourism and the Ministry for Regional Cooperation, a controversial move since part of the $2 million budget was effectively drawn from funds reserved for West Bank development.

In addition to being a biblical site, Qasr al Yehud also makes a number of political statements, as it competes for authenticity with its Jordanian neighbor, but also reiterates and reinforces the Israeli presence in the West Bank.

The Politics of Developing and Transforming the Jordan

The river that runs between the two sites has also become a more complex and layered space since the 1950s. Its image as a holy river has been overshadowed by infrastructural development, which approached the river as a utilitarian water resource system harnessed to meet the demands of a growing population in the

Raw sewage being released in the Lower Jordan River at the Alumot Dam, Israel. (Source: Francesca de Châtel, 2013)

region.

After the creation of the state of Israel in 1948, it was drawn into the regional conflict as a contested resource. Israel forcefully imposed the construction and operation of its National Water Carrier – a 200-kilometer conduit that conveys more than 300 MCM of water annually from Lake Tiberias to cities along the Israeli coast and further south to the Negev – prevented Jordanian, Lebanese, and Syrian attempts to develop the river, and entirely barred Palestinians from accessing it.

Meanwhile Syria, which lost access to the Upper Jordan River and Lake Tiberias with Israel's occupation of the Golan Heights in

The Lower Jordan River below the Alumot Dam. (Source: Francesca de Châtel, 2013)

1967, turned to the development of the Yarmouk River and its tributaries, where it built 38 dams in the following decades.

Jordan also started diverting water from the Yarmouk and Zarqa Rivers into the King Abdullah Canal. Unsurprisingly, the first victim of these unilateral development strategies was the Lower Jordan River itself, which has been reduced to around 2% of its historic flow.

In addition, water quality in this part of the river south of the Alumot Dam has been severely impaired, with saline flows, agricultural runoff, water from fishponds, and poorly treated sewage being released by all communities along the river so that its water is unsuitable for use in any sector. The degradation of the Jordan River has also caused a 50% reduction in biodiversity.

The Lower Jordan River flowing south seen from the Degania Dam and above the Alumot Dam, Israel. (Source: Francesca de Châtel, 2013)

FoEME has drawn attention to the severe degradation of the Lower Jordan River through several detailed studies and a wide-reaching international campaign to rehabilitate it.

In 2010, the organization also warned that organic pollution posed a serious public health threat at the southern baptism sites, which led to a flurry of media coverage over whether the river was safe for immersion at the baptism site in the West Bank.

The Israeli authorities subsequently issued statements declaring that the water was regularly monitored and safe for immersion. But as neither the Israelis nor the Jordanians make comprehensive long-term data publicly available, it is easy to speculate about the degree of pollution and whether it poses a public health threat.

The Yardenit Baptismal Site in Israel is far removed from such unsettling reports of polluted holy water and the history of conflict and shifting borderlines. Situated just south of Lake Tiberias before the Alumot Dam, Yardenit gives a bucolic impression of the Jordan River as a free-flowing, tree-lined river.

According to the Yardenit website, this is one of the only places along the Jordan River where the river still flows naturally. In fact, from a hydraulic point of view, the river here is an artificial reservoir, regulated by the upstream Degania Dam that controls

inflow from Lake Tiberias, and the Alumot Dam, 1.5 km downstream. The water at Yardenit is essentially the same as that in Lake Tiberias and therefore close to drinking-water quality.

The Yardenit Baptismal Site, Israel. (Source: Francesca de Châtel, 2013)

In this “pristine” setting, the site presents a bright and uncomplicated story that merges spirituality, tourism and consumerism into a seamless modern-day religious-retail experience. The visitors’ center, designed in the shape of a church’s nave, includes a large gift shop selling everything from bibles and olivewood crucifixes to holy water (125 ml, $6) and “I Was Baptized in the Jordan River” T-shirtAcross from the gift shop, the Manna Restaurant serves “biblical food,” including St. Peter’s Fish and dates produced at the nearby Kibbutz Kinneret. Outside near the baptismal pools, visitors can pick up a video recording of their own baptism ceremony and buy empty plastic bottles and jerry cans to fill up with water from the Jordan River.

Israel started releasing fresh water into the Lower Jordan River in May 2013. (Source: Francesca de Châtel, 2013)

As Yardenit is more than 100 kilometers from the two southern sites, there is less need to legitimize it as the authentic site of Jesus’ baptism – tourists who visit as part of a day tour may not even be aware that there are any other sites.

Yet, by omitting any biblical references to Bethany Beyond the Jordan and emphasizing the “scenic landscapes [described in the Bible…] that have been preserved to this day,” the site’s tourist brochure implicitly suggests that this is the authentic site of baptism, or at least the place where it can be relived most authentically.

Billed as “the perfect combination of the [sic] Christian heritage, the exciting sights of the Holy Land and the history of civilization,”

Holy water in the Yardenit gift shop, Israel. (Source: Francesca de Châtel, 2013).

the Yardenit Site – like the two southern sites – also weaves in subtle political narratives, firmly rooting the story of baptism into ancient – and, implicitly, more recent – Jewish history in the Holy Land.

The site's location on the grounds of Kibbutz Kinneret, the second kibbutz founded in Mandate Palestine, ties the biblical event of the baptism of Jesus into Zionist narratives.

Thus while the three baptism sites present themselves as religious sites that focus on biblical history and offer a space for spiritual reflection, each also represents particular political, nationalist, and economic interests, while at the same time glossing over the profound changes to the holy river itself.

Pilgrims who visit these sites appear unconcerned by or unaware of the physical changes to the river, which in their view do not affect its spiritual qualities.

Msgr. Maroun Lahham, the Latin Patriarch Vicar General of Jordan, appeared indifferent to the state of the river, considering its physicality to be almost irrelevant. "From a religious perspective it does not matter whether the water is dense or light, clear or cloudy, polluted or not polluted," he said. "This does not touch upon the aspect of faith. Pollution is a Western concern, it is Cartesian. Descartes' influence stopped on the northern shores of the Mediterranean."

The physical and spiritual realms continue to exist separately, allowing the image of the holy Jordan River to persist independently of the altered physical river. An official at Al Maghtas in Jordan said that the river's holy qualities are unchangeable. "We don't like the word 'pollution,'" he said.

"The water quality has been impaired by return flow of fertilizer, pesticides, saline water and treated and untreated sewage water along the whole river course. All this does not affect the spiritual quality of the river though: the Jordan is the Jordan. It is a holy river."

Reviving the Jordan River

Despite the continued zero-sum struggle for the river's water, efforts are being made to revive the Jordan River. FoEME has developed a comprehensive rehabilitation plan for the Lower Jordan River based on extensive research in Israel, Jordan, and Palestine.

The plan outlines concrete steps to remove pollutants from the river, return fresh water flow to it, and ensure Palestinian rights to a share of the river's water are honored. It highlights the crucial importance of cross-border cooperation and of treating the river basin as a single interconnected ecosystem that transcends political boundaries and disputes.

Partly as a result of FoEMe's advocacy efforts, Israel started releasing 1,000 m3/hour of fresh water from the Alumot Dam into the Lower Jordan River in May 2013, with a commitment to increase this amount to an annual 30 MCM.

The Israeli Ministry of Environment has also outlined a master plan for the upper part of the Lower Jordan River up to the Bezeq Stream, the border with the Palestinian West Bank.

In addition, the operation of a new sewage treatment plant near the Alumot Dam by 2015 will remove sewage from the river. If Jordanian and Palestinian plans to build wastewater treatments plants in their part of the watershed are realized, half a century of using the Jordan as a sewage canal could be put to an end, according to FoEME.

However, the removal of the various effluents discharged by Israel, Jordan and Palestine could cause the drying up of the river. FoEME therefore recommends that 400-600 MCM/year of fresh water be returned to the river and that the river be allowed to flood once a year in order to maintain a healthy ecosystem.

While critics argue that none of the riparians are willing or able to give up their acquired share of the river, FoEME says it has identified over 1 billion cubic meters of water that can be saved in Israel, Jordan, and Syria.

The organization is advocating for the establishment of an international commission to manage the Lower Jordan River basin and is currently developing a cross-border master plan. It is also working towards the creation of a transboundary ecological peace park on the border between Israel and Jordan.

FoEME's broad-ranging Jordan River Rehabilitation Project also seeks to engage and involve Christian, Jewish, and Muslim religious leaders both in the region and internationally in an effort to raise awareness of the importance of preserving the Jordan River Valley as a site of shared religious and cultural-historical heritage.

In November 2013, the organization published a series of Faith-Based Toolkits (Christian, Jewish, Muslim), which religious leaders

are encouraged to use in their sermons and activities to engage faith communities in the region and beyond.

Christian, Jewish, and Muslim religious leaders from Israel, Jordan, and Palestine also gathered at a regional conference on the Dead Sea in Jordan in November 2013 where they endorsed the Covenant for the Jordan River drawn up by FoEME. The document calls upon regional governments to work towards the rehabilitation of the Lower Jordan Valley, which "must be counted as part of the heritage of humankind."

Thus, against all odds, the first steps towards reviving the Lower Jordan River have been taken. And while the Jordan River will never return to its natural state, it could again becoming a living river and a carrier of holy water that is not only worshipped in a religious context but also revered and respected as the key to life and livelihood in this arid region. ◆

Suggested Reading

A series reports, concept documents and other publications issued by Friends of the Earth Middle East between 2010 and 2014 are available at www.foeme.org.

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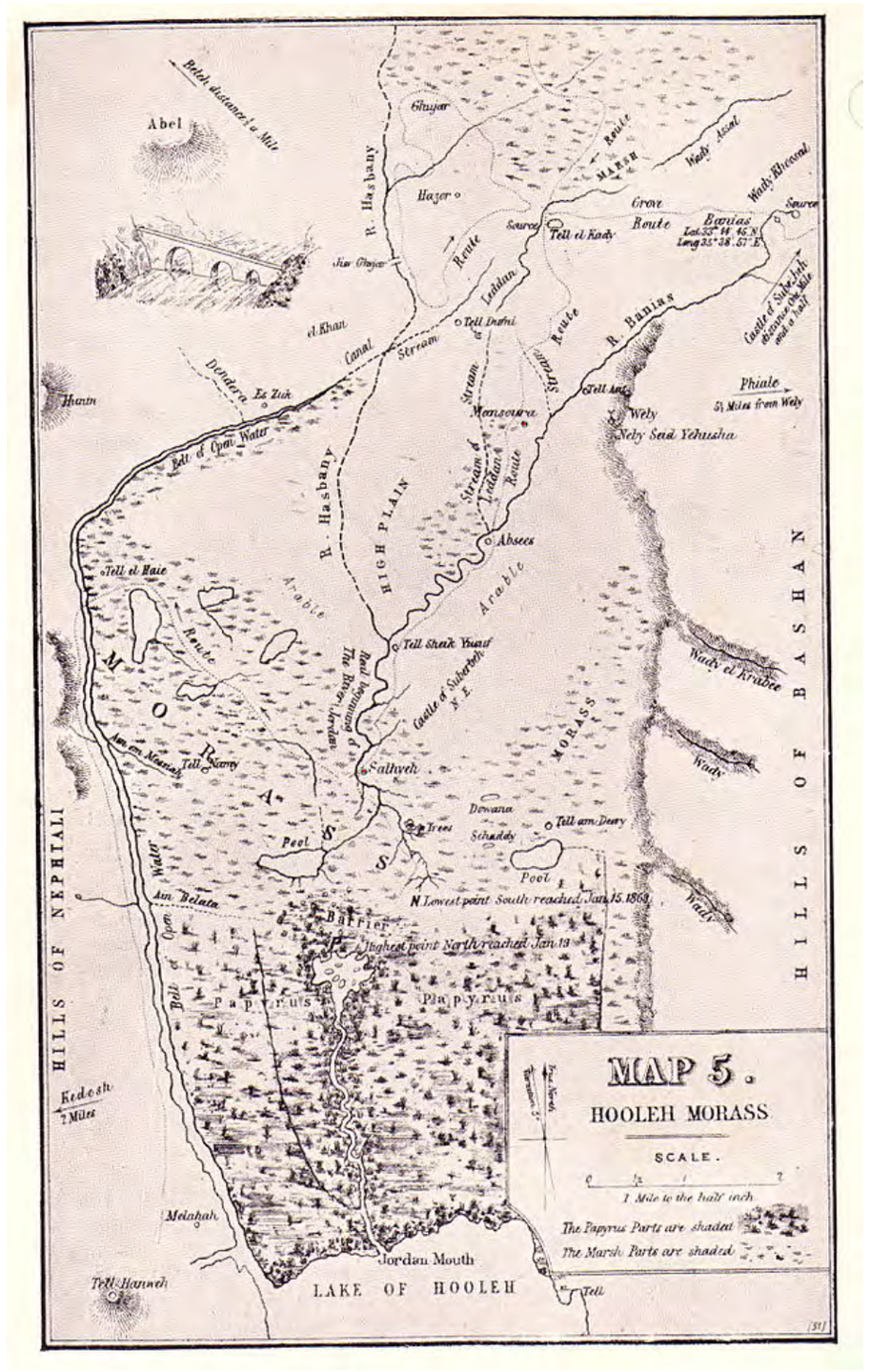
Maps and Charts

Jordan River

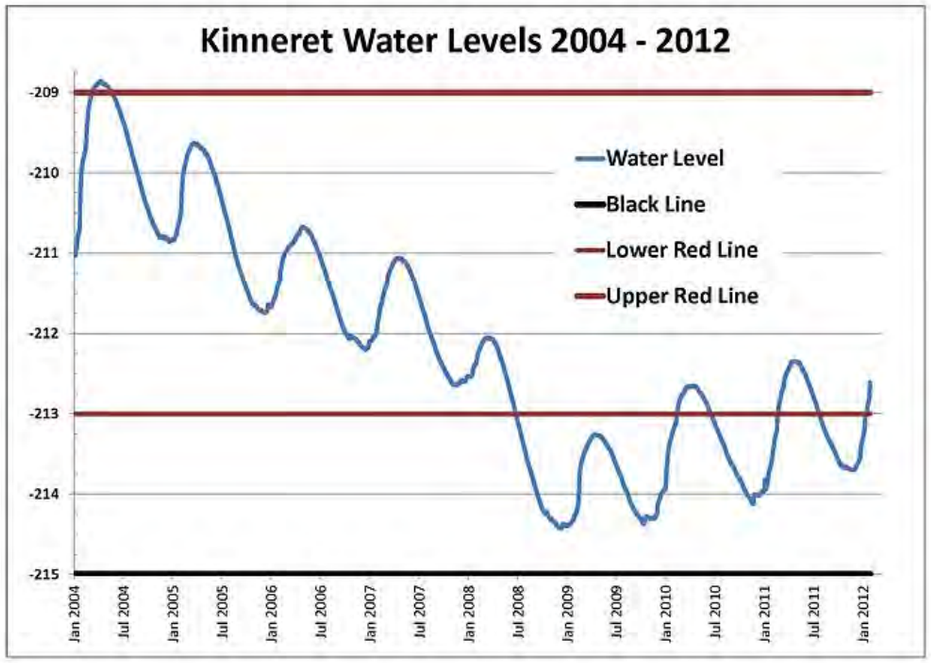
(Source: Wikipedia.org)

Map of the source of the Jordan, 1869



(Source: Wikipedia.org)

Sea of Galilee water levels January 2004 to February 2012

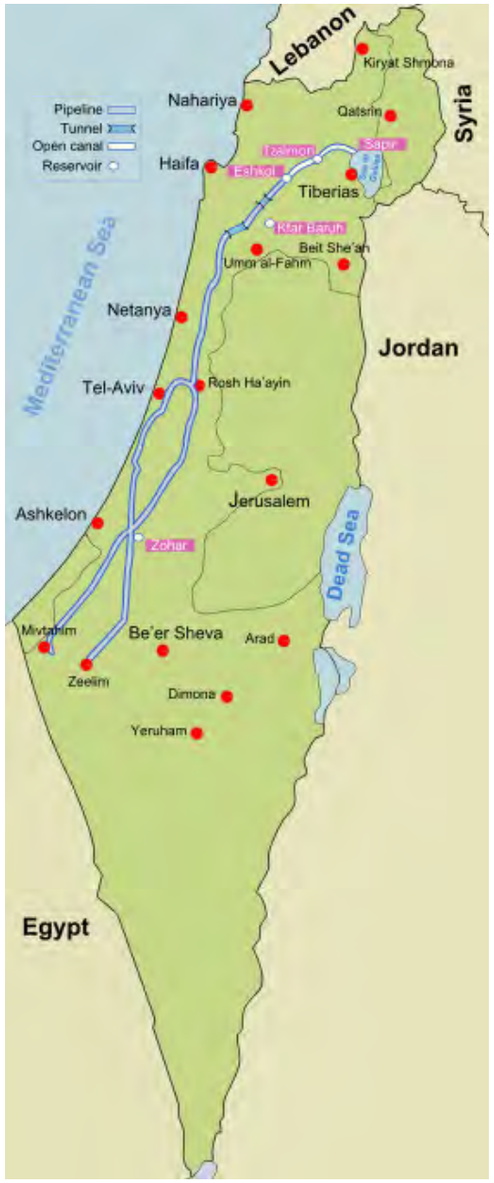


(Source: Derends, English Wikipedia.org, CC BY 3.0)

Map of the Jordan River

(Source: Ghazal Lababidi, 2014)

Map of National Water Carrier of Israel



(Source: AdamHej, Wikipedia.org, CC BY-SA 4.0)

The Madaba Map, Jordan, 6th-century CE

(Source: Soon Kim, 2013, Creative Commons)

Section 3

Who Owns the Nile? Egypt, Sudan, and Ethiopia's History-Changing Dam

EDITOR'S NOTE:

Egypt and Sudan are utterly dependent on the waters of the Nile River. Over the past century both of these desert countries have built several dams and reservoirs, hoping to limit the ravages of droughts and floods which have so defined their histories. Now Ethiopia, one of eight upriver states and the source of most of the Nile waters, is building the largest dam in Africa. Located on the Blue Nile twenty five miles from the Ethiopian border with Sudan, the Grand Renaissance Dam begins a new chapter in the long, bellicose history of debate on the ownership of the Nile waters, and its effects for the entire region could be profound.

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By ANDREW CARLSON

In the fall of 2012 newspapers around the world reported on a Wikileaks document, surreptitiously acquired from Stratfor, the Texas security company, revealing Egyptian and Sudanese plans to build an airstrip for bombing a dam in the Blue Nile River Gorge in Ethiopia. The Egyptian and Sudanese governments denied the reports.

Whether or not there were such plans in 2012, there is a long history of threats and conflicts in the Nile River Basin. Downriver Egypt and Sudan argue that they have historic rights to the water upon which they absolutely depend—and in 1979 Egyptian President Anwar Sadat threatened war on violators of what he saw as his country's rights to Nile waters. Upriver Ethiopia, Kenya, Uganda, Rwanda, Burundi, and Tanzania argue that they too need the water that originates on their lands.

Since the twelfth century C.E. Christian Ethiopian kings have warned Muslim Egyptian sultans of their power to divert waters of the Nile, often in response to religious conflicts. But these were hypothetical threats.

Today, however, Ethiopia is building the Grand Renaissance Dam and, with it, Ethiopia will physically control the Blue Nile Gorge—the primary source of most of the Nile waters.

The stakes could not be higher for the new leaders in Egypt and Ethiopia, President Mohamed Morsi and Prime Minister Hailemariam Desalegn, as well as Sudan's long-time President, Omar El Bashir. The stakes are perhaps even higher for the millions of people who owe their livelihood and very existence to the Nile's waters.

Egypt and the Nile

The Nile has been essential for civilization in Egypt and Sudan. Without that water, there would have been no food, no people, no state, and no monuments. As Herodutus famously wrote in the 5th century B.C.E., "Egypt is the gift of the Nile."

For millennia peoples have travelled along the banks of the Nile and its tributaries. Scores of ethnic groups in Egypt, Ethiopia, and Sudan share architecture and engineering, ideas and traditions of religion and political organization, languages and alphabets, food and agricultural practices.

In 3000 B.C.E., when the first Egyptian dynasty unified the lower and upper parts of the Nile River, there were no states in Eastern or Central Africa to challenge Egypt's access to Nile waters.

The Nile was a mysterious god: sometimes beneficent, sometimes vengeful. Floods between June and September, the months of peak flow, could wipe out entire villages, drowning thousands of people. Floods also brought the brown silt that nourished the delta, one of the world's most productive agricultural regions, feeding not only Egypt but many of its neighbors.

The river's central importance to Egyptian life is captured in A Hymn to the Nile, recorded in Papyrus Sallier II:

Hail to thee, O Nile, that issues from the earth and comes to keep Egypt alive! …
He that waters the meadows which He created …
He that makes to drink the desert …
He who makes barley and brings emmer into being …
He who brings grass into being for the cattle …
He who makes every beloved tree to grow …
O, Nile, verdant art thou, who makes man and cattle to live.

The Nile's seasonal flooding is a central theme in Egyptian history. The river flow follows regular patterns, increasing between May 17 and July 6, peaking in September, and then receding until the next year. But the river volume is very unpredictable, as documented by nilometers (multi-storied structures built in the river to measure water heights). Successive empires of Pharaohs, Greeks, Romans, Christian Copts, and Muslims celebrated the rising waters of the Nile and dreaded floods or droughts.

Five millennia of Nile history show how years with high water have produced ample food, population growth, and magnificent monuments, as during the first five dynasties from 3050 B.C.E. to 2480 B.C.E. Periods with low water have brought famine and disorder. The Book ofGenesis describes seven years of famine that historians associate with the drought of 1740 B.C.E.

From the time of the Pharaohs until 1800 C.E., Egypt's population rose and fell between 2 to 5 million, due to food availability and epidemics. The irrigation projects of the 19th century Ottoman ruler Mohammad Ali allowed year-around cultivation, causing population growth from 4 to 10 million. Since the opening of the Aswan High Dam in 1971, Egypt's population has increased from about 30 to 83 million.

The Sources of the Nile

Despite the extraordinary importance of the Nile to people downstream, the origin of the great river was a mystery until the middle twentieth century. Herodotus speculated that the Nile arose between the peaks of Crophi and Mophi, south of the first cataract. In 140 C.E. Ptolemy suggested the source was the Mountains of the Moon, in what are now called the Ruwenzori Mountains in Uganda.

The 11th century Arab geographer al-Bakri postulated West African origins, confusing the Niger River, which empties into the Atlantic Ocean, with the Nile River. In 1770 the Scottish explorer James Bruce claimed his discovery of the source in Ethiopia, while in 1862 John Hanning Speke thought he found it in Lake Victoria and the equatorial lakes.

The river's limited navigability only increased its mystery. The Blue Nile River descends 4501 feet in 560 miles from Lake Tana in the Ethiopian highlands through a deep gorge with crocodiles, hippopotamuses, and bandits to the Sudan border and the savannah. Despite the efforts of scores of intrepid adventurers, the Blue Nile in Ethiopia was not successfully navigated until 1968 by a team of British and Ethiopian soldiers and civilians equipped by the Royal Military College of Science.

The Sudd, a swamp in South Sudan, contributes to the Nile's historic lack of navigability. (Source: Wikimedia Commons)

Further south up the White Nile in the lakes and rivers of Burundi, Rwanda, Kenya, Tanzania, and Uganda, the Egyptian cultural influence is less pronounced, due to the Sudd, a gigantic and impassable swamp which absorbs

waters from the equatorial lake tributaries. The Nile River historian Robert O. Collins reports that “no one passed through this primordial bog” until 1841.

Not until the 20th century did it become clear that the Nile is part of a vast river system with dozens of tributaries, streams, and lakes, stretching from the Mediterranean Sea to the remote mountains of Burundi, in tropical central Africa, and to the highlands of Ethiopia, in the Horn of Africa.

Spanning more than 4,200 miles, it is the longest river in the world. It has also become clear that the volume of water which flows through the Nile is relatively small—a mere two percent in volume of the Amazon’s and fifteen percent of the Mississippi—and mostly (86%) from Ethiopia.

Ethiopia, Egypt, and the Historical Struggle for the Nile’s Waters

Ethiopia and Egypt have had a long relationship of both harmony and discord, the latter the result of religious issues and access to Nile water, among other factors.

Ethiopia’s first well documented government was in Aksum, a city-state that controlled a large empire from the Ethiopian highlands across the Red Sea to Yemen. From 100 until 800 C.E. Aksumites participated in Mediterranean and Indian Ocean trade.

The cultural relationship between Egypt and Ethiopia was institutionalized when the Aksumite King Ezana converted to Christianity in 330 C.E. For 16 centuries (until 1959) the Egyptian bishop of the Ethiopian Orthodox Church was appointed by the Egyptian patriarch in Alexandria, often under the influence of the Egyptian government.

Ethiopians were profoundly influenced by the Middle East, even writing their state and geography into Bible stories. The source of the Blue Nile became the Gihon, one of the four rivers that flowed from the Garden of Eden. The 14th century C.E. myth of national origins connected Ethiopia’s rulers to the Old Testament. In this legend the Queen of Sheba (Mekedda), journeyed north from Ethiopia to Jerusalem to meet King Solomon in 900 B.C.E. A romantic relationship produced a child, Menelik I, the first in Ethiopia’s Solomonic Dynasty.

When Menelik became an adult, despite his father’s wish that he become the next King of Israel, he escaped to Ethiopia with the Ark of the Covenant—the cabinet which contained the tablets of the ten commandments given by God to Moses on Mount Sinai. Menelik stored the Ark on an island in Lake Tana—into which the Gihon flows—before it was moved to Aksum, where many Ethiopians believe the Ark remains to this day. Another Ethiopian legend is that Mary and Jesus stayed a night on that same island (Tana Cherquos) during their flight from the Holy Land to Egypt.

The Muslim conquest of Egypt in 640 C.E. put Christian Ethiopia in a defensive position. Because the Ethiopian Orthodox Church remained subordinate to the Orthodox Church in Alexandria, and Egypt had become a Muslim country, Ethiopians became suspicious and resentful of the control Egypt had on the appointment of their Christian bishop (abun). Muslim Egyptians also controlled Jerusalem and had the power to expel Ethiopian pilgrims to their holiest of cities.

So Ethiopians began to claim power over Egypt through control of the Nile. During the Crusades the Ethiopian emperor Lalibela (1190-1225)—who built a new Jerusalem in Ethiopia, safe from Muslim occupation in magnificent, underground rock-hewn churches—threatened retribution by diverting the Tekeze River from its pathway north into Sudan (where it becomes the Atbara and then joins the Nile).

The first Egyptian to write about the potential for an Ethiopian diversion of the Nile was the 13th century Coptic scholar Jurjis al-Makin (d. 1273).

Stories about Ethiopia's power over the Nile inspired the 14th century European legend of Prester John, a wealthy Christian Ethiopian priest king. In 1510 the legend returned to Ethiopia with Portuguese explorer Alfonso d' Albuquerque, who considered the possibility of destroying Egypt by diverting the Nile to the Red Sea. In 1513 d'Albuquerque even asked the Portuguese king for workers skilled in digging tunnels. Nothing came of the plan.

But conflict between Egypt and Ethiopia continued, often as proxy wars between Christians and Muslims on Ethiopia's northern or southeastern borderlands. The sixteenth century invasion of Ethiopia by Ahmad Gragn, the Muslim imam from the Adal Sultante, was seen as an Egyptian conflict.

In the nineteenth century Egypt and Ethiopia fought over control of the Red Sea and upper Nile Basin. The climax came in 1876 at the Battle of Gura in present day Eritrea where the Ethiopians delivered a humiliating defeat to the Egyptian army.

Colonial-Era Conflicts over the Nile

The European partition of Africa in the 1880s added huge complexity to this conflict.

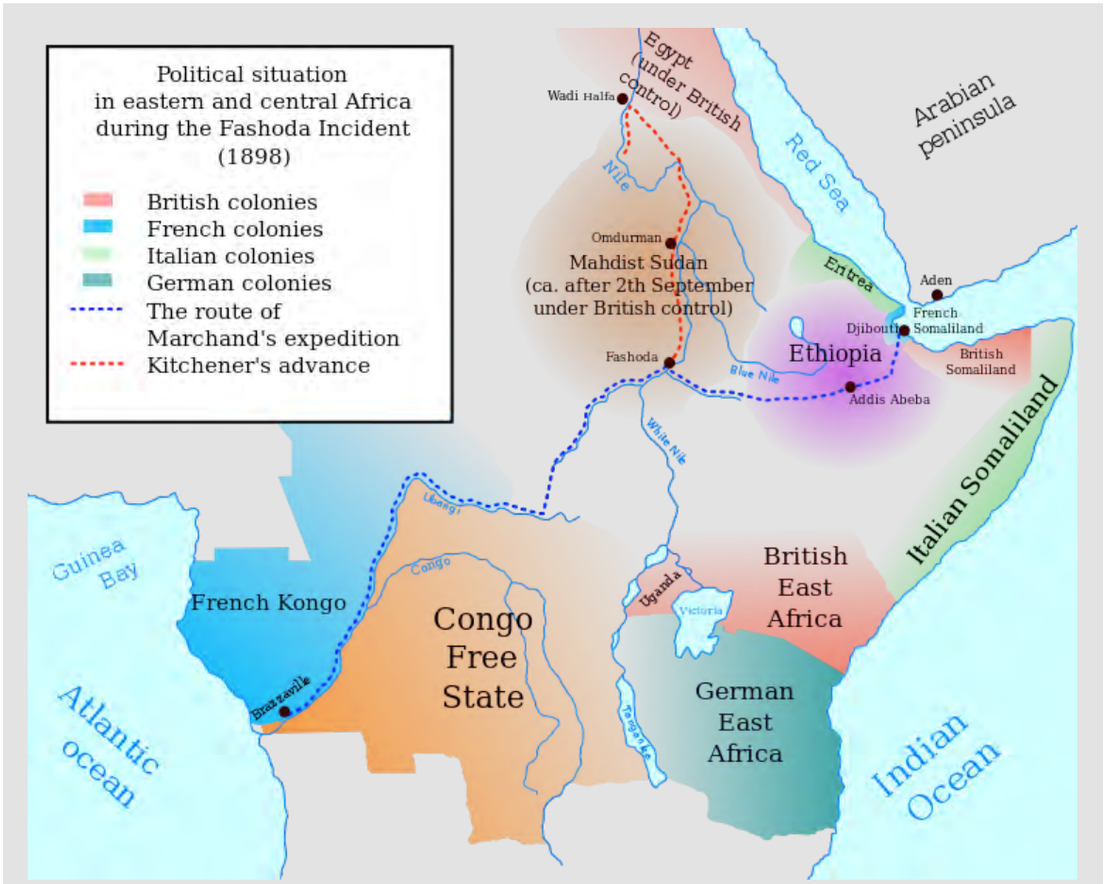
Egypt was colonized by England in 1882. Ethiopia defeated the Italians at the Battle of Adwain 1896 becoming the only African country to retain its independence during the "scramble for Africa." But colonization created many new states in the Nile Basin (Eritrea, Uganda, Rwanda, Burundi, Kenya, and Tanganika) and set off new competition for resources and territory.

Egypt was prized for the Nile Delta, a region of unsurpassed agricultural productivity. After the completion of the Suez Canal in 1869, Egypt also offered access to the Red Sea and the Indian Ocean. For the British control of Egypt meant more profitable

trade with India, its richest colony. For the French, the canal offered quicker access to Indochina, its most lucrative colony.

In the late nineteenth century, since controlling Egypt was the key to Asian wealth, and since Egypt depended on the Nile, controlling the source of the Nile became a major colonial goal.

The French-English competition for control of the Nile Basin climaxed in 1898 at Fashoda.



The Fashoda Incident, 1898, was the climax of imperial territorial disputes during the "scramble for Africa." (Source: Wikimedia Commons)

The French conceived of the idea of building a dam on the White Nile, so as to undermine British influence further downriver and establish east-west control of the continent. They organized a stupendous pincer movement with one group of soldiers traveling from East Africa across Ethiopia and the other from West Africa across the Congo.

The British heard of the French expedition, and, having just captured Khartoum ordered a fleet of gun boats and steamers with soldiers under the leadership of General Horatio Herbert Kitchener upriver to Fashoda, the site of the proposed dam. With fewer than 200 men, the French were embarrassed. In 1899 the two colonial powers reached an agreement which designated to France the frontiers of the Congo River and to England the frontiers of the White Nile.

The Fashoda Incident revealed how little Europeans understood about the Nile River. Thinking that most of the Nile waters came from the equatorial lakes (Victoria, Albert, Kyoga, and Edward), the English spent enormous energy on plans to increase White Nile water flows.

First called the Garstin Cut and later the Jonglei Canal, the British intended to create a channel that would maximize water transfer through the great swamp (where half of it evaporated).

One of the most expensive engineering projects in Africa, it was terminated in 1984 by the Sudan People's Liberation Army,

because of the severe disruption it brought to the lives of the indigenous upper Nile peoples. If the 300 mile-long Jonglei Canal had been completed, it would have increased water flows by nearly 4 billion cubic meters into the White Nile.

Negotiating the Nile: Treaties and Agreements over the Nile Waters

Treaty negotiations about Nile waters started during the colonial era as England tried to maximize agricultural productivity in the delta.

In 1902 the British secured from the Ethiopian Emperor Menelik II an agreement to consult with them on any Blue Nile water projects, especially on Lake Tana. As the controlling imperial power in East Africa, agreements with Kenya, Tanganika, Sudan, and Uganda werepro forma, internal colonial matters.

The Blue Nile originates in the heart of Ethiopia at Lake Tana. (Source: Wikimedia Commons)

After achieving its independence in 1922, Egypt negotiated the Nile Waters Agreement of 1929 with the East African British colonies. This accord established Egypt's right to 48 billion cubic meters of water flow, all dry season waters, and veto-power over any upriver water management projects; newly independent Sudan (1956) was accorded rights to 4 billion cubic meters of water. The Ethiopian monarch was not consulted—at least in part because no one understood how much Nile water actually came from Ethiopia.

The 1959 Nile Waters Agreement between Egypt and Sudan was completed before all the upriver states achieved independence: Tanganika (1961), Uganda (1962), Rwanda (1962), Burundi (1962), and Kenya (1963).

The signatories of the 1959 Agreement allocated Egypt 55.5 billion cubic meters of water annually while Sudan was allowed 18.5 billion cubic meters. These 79 billion cubic meters represented 99% of the calculated average annual river flow.

The treaty also allowed for the construction of the Aswan High Dam (completed in 1971), the Roseires Dam (completed 1966 on the Blue Nile in Sudan), and the Khashm al-Girba Dam (completed in 1964 on the Atbara River in Sudan).

The treaty so negatively affected the upriver states that it provided the inspiration for the Nyerere Doctrine, named after independent Tanzania's first president, which asserted that former

colonies had no obligation to abide by treaties signed for them by Great Britain.

Emperor Haile Selassie was offended by President Nasser's exclusion of Ethiopia in the Nile Waters Agreement and in planning for building the Aswan Dam. He negotiated the 1959 divorce of the Ethiopian Orthodox Church from the Orthodox Church in Alexandria, ending 1600 years of institutional marriage.

He also began planning for several dams on the Blue Nile and its tributaries, contributing $10 million dollars from the Ethiopian treasury towards a study by the U.S. Department of Reclamation resulting in a seventeen volume report completed in 1964 and titled Land and Water Resources of the Blue Nile Basin: Ethiopia.

Nasser responded by encouraging Muslims in Eritrea (reunified with Ethiopia after World War II) to secede from Ethiopia. He also encouraged Muslim Somalis to fight for the liberation of Ethiopia's Ogaden region.

Ethiopia won the war with Somalia in 1977-78 and retained the Ogaden. Its 30 year war with Eritrea, an Egyptian ally, came at a tremendous cost. Haile Selassie was overthrown in 1974, and after 1993 Eritrea won independence and Ethiopia became a landlocked country—although it still possessed the headwaters of the Blue Nile.

In the middle of the 1980s, rains failed in the Ethiopian highlands, causing a serious water crisis upriver and downriver. One million

Ethiopia lost its Red Sea coastline when a civil war resulted in the secession of Eritrea. (Source: Wikimedia Commons)

Ethiopians died as a result of drought and famine—made worse by Civil War with Eritrea. Egypt averted disaster but Aswan's turbines were nearly shut down, creating an electric power nightmare; and crops failed in the delta, bringing the real prospect of famine.

As a result, Egyptians came to understand that their great Aswan Dam had not solved their historic dependency on upriver Nile water. In 1987, after years of hostile rhetoric, the Egyptian President Hosni Mubarak and the Ethiopian President Haile

Mariam Mengistu replaced the language of threat and confrontation with words of conciliation and cooperation.

Then in the 1990s the Ethiopian rains returned and, remarkably, Hosni Mubarak redoubled efforts begun during the Sadat administration to build the Toshka Canal, one of the world's most expensive and ambitious irrigation projects. This plan would take 10% of waters in Lake Nasser to irrigate Egypt's sandy Western Desert, increasing Egypt's need for Nile water even if they maintained their 1959 treaty share of 55 billion cubic meters.

In anger and disbelief, the Ethiopian Prime Minister Meles Zenawi protested: "While Egypt is taking the Nile water to transform the Sahara Desert into something green, we in Ethiopia—who are the source of 85% of that water—are denied the possibility of using it to feed ourselves."

He then began plans for the Grand Renaissance Dam.

International water law has not resolved differences about ownership of Nile Waters. The Helsinki Agreement of 1966 proposed the idea of "equitable shares"—and the idea was taken up again in the 1997 United Nations Convention on the Law of Non-Navigational Uses of International Watercourses.

A proposal for "equitable shares" was again put forward in the 1999 Nile Basin Initiative, which included all the affected countries. Unfortunately the initiative did not resolve the conflict

The Blue Nile Falls fed by Lake Tana near the city of Bahar Dar, Ethiopia forms the upstream of the Blue Nile. (Source: Wikimedia Commons)

between Egypt and Sudan's claims of historic rights and the upper river states' claims for equitable shares.

In 2010, six upstream countries (Ethiopia, Kenya, Uganda, Rwanda, Burundi, and Tanzania) signed a Cooperative Framework Agreement seeking more water shares. Egypt and Sudan rejected the agreement because it challenged their historic water rights.

Ethiopia and the Lessons of Dam Building

Beginning of the Blue Nile River by its outlet from Lake Tana. Photo by Ondřej Žváček. (Source: Wikimedia Commons)

One lesson from the last century of mega-dam building is that upriver countries have the most power when negotiating water rights. The first of the mega-dams, the Hoover Dam on the Colorado River in the United States, cost Mexico water. The Ataturk Dam in Turkey has had a devastating impact on downriver Syria and Iraq. China and Tibet control waters on multiple rivers flowing downstream to India, Pakistan, Myanmar, Bangladesh, and Vietnam.

Another lesson is that mega-dams have enormous and unanticipated environmental impacts. The Aswan High Dam has disrupted the ecosystems of the river, the delta, and the Mediterranean with results of reduced agricultural productivity and fish stocks. It also caused a series of seismic events due to the extreme weight of the water in Lake Nasser, one of the world's largest reservoirs.

Although late to mega-dam building, Ethiopia is now making up for lost time. One of the tallest dams in the world was completed in 2009 on the Tekeze River in northern Ethiopia. Three major dams on the Omo and Gibe Rivers in southern Ethiopia are either completed or nearly so.

The biggest of Ethiopia's water projects, the Grand Renaissance Dam, will have a reservoir holding 67 billion cubic meters of water —twice the water held in Lake Tana, Ethiopia's largest lake—and is expected to generate 6000 megawatts of electricity.

Ethiopians hope these water projects—which extend to 2035 with other Nile tributaries and river systems—will lift their country out of poverty. Similar large dams have produced economic miracles in the United States, Canada, China, Turkey, India, Brazil, and, of course, Egypt.

Ethiopia's options for economic development are limited. With nearly 90 million people it is the most populous landlocked country in the world. It is also one of the world's poorest countries —174 on the list of 187 countries in the United Nations Human Development Index for 2012. (Sudan is 169 and Egypt 113.) This index rates countries based on life expectancy, education, and income, among other criteria.

Part of Ethiopia's challenge is that 85 percent of the workforce is in agricultural commodities that bring low profits. Ethiopia is already leasing land in its southern regions to Saudi Arabia, India,

and China for large irrigated water projects—despite severe land shortage in its northern regions—because it does not have the funds to develop this land on its own.

If Ethiopia cannot use its elevation and seasonal rains for hydro-electric power and irrigation, what is it to do?

The Grand Renaissance Dam

The state-owned Ethiopian Electric Power Corporation optimistically reports that the Grand Renaissance Dam will be completed in 2015 at a cost of nearly 5 billion dollars. As of 2013, the project is 13% complete, suggesting that it may be many years and billions of dollars before the dam is finished. The Tekeze dam was well over its predicted budget and years behind schedule.

The major obstacle to completion is financing.

The World Bank, the European Investment Bank, the Chinese Import-Export Bank, and the African Development Bank provided financing for some of the other dams; but concerns about the environmental and political impact of this latest dam have discouraged lenders.

The International Monetary Fund suggested that Ethiopia put the dam on a slow track, arguing that the project will absorb 10% of Ethiopia's Gross Domestic Product, thus displacing other necessary infrastructure development.

Nevertheless the Ethiopian government insists that it will stick with its schedule and finance the project domestically. It probably will secure more help from China, a loyal ally and the world's major developer of hydroelectric power.

The Ethiopians argue that the Grand Renaissance Dam could be good for everyone. They contend that storing water in the deep Blue Nile Gorge would reduce evaporation, increasing water flows downstream.

The Ethiopians also argue that the new dam will be a source of hydroelectric power for the entire region and will manage flood control at a critical juncture where the Nile Gorge descends from the Ethiopian highlands to the Sahel, thus reducing risk of flooding and siltation, extending the life of the dams below stream.

Egypt and Sudan are understandably concerned about Ethiopia's power over Nile waters. What happens while the reservoir behind the Grand Renaissance Dam is filling up, when water flow may be reduced 25 % for three years or more? After the reservoir is filled what will happen when rains fail in the Ethiopian highlands? Who will get the water first?

If the question of Nile waters was sensitive in the centuries before 1900, when Ethiopia and Egypt each had populations of 10 million or less, what will happen over the next twenty years, as

their populations each surpass 100 million and the collective population of the Nile River Basin countries reaches 600 million?

The Grand Renaissance Dam poses a question as basic as water itself: Who owns the Nile? When the Grand Renaissance Dam closes its gates on the Blue Nile River, whether it is in 2015 or 2025, the time for a final reckoning will have arrived.

Ethiopia will then have the power to claim its water shares, with the backing of all the upriver states. Egypt and Sudan's claims to historic water rights will have become merely hypothetical. In the context of a difficult history, violence is a possibility, but good solutions for all can be achieved through diplomacy and leadership. ◆

Suggested Reading

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Maps and Charts

Lake Nasser

Map of Egypt showing the location of Lake Nasser and the Toshka Lakes. (Source: Wikipedia)

The White Nile Meets the Blue Nile

The confluence of the Blue Nile and the White Nile is also the location of Khartoum, capital of the Republic of Sudan. (Source: Wikipedia)

Additional Image

Nile River Watershed

A topographic map of the Nile River watershed with political boundaries in red. (Source: Wikipedia)

Toshka Canal Construction

The Toshka Canal, one of the world's most expensive and ambitious irrigation projects, would take 10% of waters in Lake Nasser to irrigate Egypt's sandy Western Desert, increasing Egypt's need for Nile water. (Source: Wikimedia Commons)

Section 4

Dry Days Down Under: Australia and the World Water Crisis

EDITOR'S NOTE:

For several years now, Australia, the driest inhabited continent, has been suffering perhaps the worst drought in its recorded history. Amidst disappearing rivers and empty dams, farmers have watched their fields go barren and their livestock perish, while urban dwellers face greater and greater restrictions on water use. Terrible wildfires have swept through the country, scorching millions of acres of land. The drought is challenging Australians' very idea of who they are as a people and their faith in the future. Australia is hardly alone with these problems, as much of the globe struggles with insufficient, polluted, oversubscribed, and increasingly expensive water. How successfully Australia responds to its current water woes will offer an important road map for others around the world. This month historian Nicholas Breyfogle puts the current Australian drought into historical perspective.

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By NICHOLAS BREYFOGLE

Australia has water troubles.

For at least the past nine years, the people "down under" have been experiencing perhaps the worst drought of their history, the "Big Dry," as they're calling it.

The drop in rainfall and river flows has been most severe in the southern and eastern states (Victoria, New South Wales, South Australia, and parts of Queensland), which happen to house the majority of Australians and also the country's major agricultural centers. Dry days—dry decades, in fact—are also dogging Western Australia's major city, Perth.

A sign illustrating Level 5 Water Restrictions in Goulburn, New South Wales, 2006, during the worst of Australia's decade-long drought. Australia's unique rainfall patterns and long history of human transformation of water combined to produce the "Big Dry," and Australians continue to struggle over how to respond to the challenge that repeated drought poses to their future. (Source: Bidgee)

Australia, with its approximately 22 million people, has by some estimates the planet's 15th largest economy. But the current drought has abruptly reminded

Australians of the limits that natural resources and climate place on human activity.

Although rains this past winter have done their part to mitigate the worst of the drought, over the last decade city residents have been placed on stringent water-use restrictions in an effort to reduce daily consumption: gardens have gone unwatered and people showered with buckets to catch the water for other uses.

Even with the strictest of limitations in place, the threat that the water could run out confronted each of Australia's cities. In 2007, word in Brisbane was that without sufficient rain, the city would run dry in 2009. The same year, the people of Adelaide were told that "critical human needs" might not be met in the future.

To make matters worse, thirsty animals have been barging their way into human settlements. Snake bites are on the rise in Victoria and New South Wales as venomous snakes across southeastern Australia have slithered to urban areas in search of water. In November 2009, about 6,000 camels overran the outback town of Docker River in the Northern Territory (pop. 350) in search of water, head-butting water tanks, trampling fences, and licking water from air conditioning units.

If the urban areas have found their lifestyles cramped, the agricultural sector has been devastated by the drought. Irrigation farmers who specialize in "thirsty" but highly profitable crops like rice and cotton have been especially hard hit.

By 2008, rice growing came to a standstill, falling 98% across the country. The rice mill in Deniliquin (New South Wales), which alone used to produce rice for as many as 20 million people around the world, shut its doors. The result was a global shortage, with world rice prices doubling and violent food protests erupting across the globe.

Pastoral livestock farmers have also suffered. "I can't stand lying in bed every night and hearing the cattle bellow from hunger," lamented dairy farmer Malcolm Adlington in 2009 to a National Geographic reporter.

Water trough on a sheep farm 50km north of Deniliquin, New South Wales. (Source: Wikipedia)

Not long ago, Anna Creek in South Australia was home to the planet's largest cattle station—24,000 square kilometers, larger than Israel—but now there are few cattle left. Most have been sold off, but carcasses of the less fortunate dot the landscape.

And the price tag for this agricultural breakdown has been high for the Australian government: several billon dollars in drought relief to rural areas since 2001.

To make matters worse, Australia's fragile ecosystems are also in crisis. The most important river system, the Murray-Darling Basin (MDB), is suffering severe environmental distress. The Basin covers 14% of Australia and produces 40-45% of all of Australia's agriculture (A$14 billion/year).

Red Gum Tree suffering water stress, July 2009. (Source: photo by author)

All through the catchment, wetlands have disappeared to disastrous results. Today, 75% of the long-lived, majestic River Red Gum trees are considered dying or stressed, and the birds and fish that relied on the river's water to breed are failing.

In recent years, as more and more water has been diverted for human usage, the Murray has dried up before reaching the sea. The extreme drop in fresh water has raised the salinity levels of the vibrant coastal ecosystem known as the Coorong and two nearby lakes, Albert and Alexandrina. Wholesale changes in flora and fauna are underway and, in the case of Albert, the receding water has exposed acid sulphate soils to the air producing poisonous sulfuric acid across large segments of the dry lakebed.

The drought, along with record high temperatures and strong winds, has also helped to spark bushfires. Black Saturday (February 7, 2009) saw ferocious wildfires tear through the state of Victoria, killing as many as 200 and reducing more than a million acres to ashes. It was Australia's worst peacetime disaster.

And the wildfires will make the drought worse. The new trees that grow up in the place of the burned-out forests require more water to thrive than do mature ones. With more of the precious rainfall diverted directly into the roots of these young saplings, there is less that flows into the rivers to then be used by humans, animals, and plants downstream. Like much in nature, the drought is a self-reinforcing event.

How, we should ask, has it come to all this?

Australia's water woes are, in part, a result of natural climate and hydrological rhythms that have characterized the continent for millennia (although transformed of late by climate change).

They are also the result of significant human meddling in the environment that has taxed the country's water and ecological systems to the point of collapse. Human transformations (especially through river regulation and irrigation) have intensified the extent of the drought while limiting the choices Australians have to alleviate its worst effects.

Australia is hardly alone in their water troubles. Much of the planet finds itself these days confronting serious water issues of one sort or another. In this way, Australia is likely to play the role of canary in the coal mine. The successes and failures of Australians to confront the Big Dry will be lessons that the rest of the world will ignore at its peril.

"A Sunburnt Country .... Of droughts and flooding rains"

Australia is no stranger to drought, as these words of 19th-century poet Dorothea Mackellar remind us. It is the driest inhabited continent (only Antarctica receives less annual rainfall) and the current drought is explained in great part by the cyclical (if unpredictable) rainfall patterns that have long typified Australian weather.

Droughts affect parts of Australia every few years and major droughts come at least once per generation. The Big Dry is one in a long series.

The Federation Drought (1895-1903)—so named because it coincided with Australia's birth as an independent and united nation—has long been considered the worst in Australian history. By 1902, Sydney's water supply was running out, and the New South Wales government declared a day for "humiliation and prayer" to bring rains. The number of sheep in the country was cut in half—from 91 million to 54 million—and almost 5 million cattle died. In 1903, horrifying dust storms raged.

Similar major droughts ravaged the landscape during the 20th century: in 1911-16, 1939-45, 1958-68, 1979-83, and 1997-98.

Australia is also no stranger to floods. Seasonal flooding causes as much as $400 million a year in damages, and major floods appear on a regular basis. Just this March, southwest Queensland experienced its worst flooding in a century.

Between droughts and floods, one of the most defining characteristics of Australia's climate and hydrologic structures is the extreme variability of rainfall: from year to year and seasonally.

Scientists generally argue that Australia's cycle of boom and bust rainfall is the result of processes in the neighboring Pacific, Indian and Southern Oceans.

In particular, weather patterns in the South Pacific are crucial to the continent's climatic fortunes, especially El Niño events (which appear every 2-7 years and bring drought to southeastern Australia) and La Niña (rains and floods). Variations in air pressure in the tropical western Pacific (measured by the Southern Oscillation Index) and differences in sea temperature in the Indian Ocean (the Indian Ocean Dipole) are also driving forces of Australia's weather.

Australia is also characterized by high regional variation of rainfall, with 25% of the landmass receiving 75% of the precipitation. In fact, Australia has more water per capita than any other continent, but it all tends to come in huge batches and to land in parts of the country that are relatively unpopulated.

Australia is subject to significant drought for other reasons, including its latitude (with much of the country lying in the extremely dry belt between 15 and 35 degrees south of the equator) and its relative flatness (which means less rain and higher rates of evaporation).

Importantly too, Australia has the lowest run-off of any continent —that is, the lowest percentage of rainfall that actually makes its way into rivers, lakes, and other freshwater bodies: only 10% on average, compared to approximately 52% in North America, 48% in Asia, 39% in Europe, and 38% in Africa.

"Water Dreamers"

Yet, for all the variability built into Australia's climate and its propensity for drought, the current dry period is not simply an outcome of the continent's cyclical climatic patterns of wet and dry. It is also the result of what European settlers have done to transform and extensively regulate Australia's water flow since the First Fleet sailed into Sydney harbor in 1788. Through their history, Australians have often been, in the insightful phrasing of historian Michael Cathcart, "water dreamers."

The story of water during the opening days of Sydney's history unveils a pattern that has characterized much of Australian history since: the repeated, often desperate search for sufficient water; the enduring hopefulness that each new water source or hydro-engineering feat would "solve" the water problem; the boundless faith that they could make bounty pour forth from even the most arid lands; the ruination of ecosystems in the effort to redirect water; exploding costs for water projects that often produced unexpected and unwanted consequences; and tensions between private corporations and government officials, and between Europeans and Aboriginal peoples.

Over the centuries, animals and plants in Australia adapted to the arid, boom-bust cycles. The Aboriginal peoples—who arrived in Australia some forty to sixty thousand years ago—also developed

their social, economic, migratory, and religious activities around the natural cycles of wet and dry.

By contrast, the Europeans who arrived in Australia were wetland people, and they had a hard time making sense of Australia's particular climate and hydrology. Instead of the water systems that they knew from Europe, they found "rivers that spread out into swamps then disappeared into huge reed beds; rivers that dried out, that went underground then reemerged further down the river bed; rivers that were salty; rivers that were chains of ponds; rivers that consisted of dry, sandy beds," as journalist Åsa Wahlquist has written.

The initial water supply in Sydney, the Tank Stream, quickly became a site of contention—and disastrously polluted—as local elites built houses next to the stream, into which they poured their sewage and the run-off from the pigs in their yards and their tanneries and other manufactories.

Those who could afford it paid water carters a handsome price to lug water for them from swamps at some distance from the settlement. As the water carters served primarily the rich, and any drinkable water became scarcer, local society came to argue that government authority needed to intervene to ensure water for all.

They turned to water sources farther afield. First came the Lachlan swamps about three kilometers from Sydney. Local officials planned to pipe water from the swamps to a central holding tank from which they would run water into the center of Sydney. Convicts were put to work building the water tunnel in a project that took substantially longer and cost a great deal more than planners had anticipated. Ultimately, the water was quickly squandered. No gate was included at the terminus, so the water simply poured out onto the streets. And very soon the swamps began to dry up, ending the water source and destroying the local ecology in the process. Then Sydney turned to the Botany swamps, with similar results.

The taking of these waters worsened already tense relations with the Aboriginal Cadigal people who had relied on these same waters for generations, and for whom the draining of marshes and the felling of trees was a spiritual and cultural affront as well as a threat to their existence.

The Water Seekers

Very soon after the initial Sydney settlement, the anxious if ever hopeful search for water intensified in scope. Through the early nineteenth century, there were a series of explorations—highly publicized, well funded, and ultimately fruitless—sent into the interior of Australia in search of a great river or an inland sea that would be the salvation of Australia.

Even in the face of thirst-induced deprivations, delusions, and occasionally death—and all manner of physical evidence to the contrary—these water explorers maintained a powerful, self-

deluding optimism that the great river was just around the next corner (or over the next dune). Somehow or other the dryness would be conquered and a prosperous Eden would be created. The question was not if but when and how.

Leading Australians believed that if only a major river could be found, then the inevitable Golden Age of Australia would be attained. And they felt sure one must be out there. America had its Mississippi; Brazil its Amazon; China its Yangtze, how could it be possible that a continent as large as Australia would not have a similar river?

The absence of such a river, and the Europeans' inability to master Australia's waters, became linked in their minds with concerns about their colonial mission. Failure to find water, and failure to put this water to productive use, would entail a failure of Europeans to "civilize" the new continent. It would leave open the discomforting question—were they no better than the Aboriginal peoples who they chastised for not having developed "civilized" agricultural communities?

The line beyond which

The growth of Australia's population over the first half of the nineteenth century increased the demand for agricultural land, forcing Australians to confront the environmental limitations of their new continent. The battle between water idealists and realists was soon engaged.

George Woodroffe Goyder (in 1869), Surveyor of Australia who demarcated the Goyder Line of rainfall, north of which the climate prohibited sustained agriculture. (Source: Wikipedia)

During the drought of 1865, the Surveyor General of South Australia, G. W. Goyder, took extensive surveys of the native vegetation near Adelaide and determined a geographic line north of which it was no longer safe to practice agriculture.

In 1872, all land south of Goyder's line was officially opened to settlement, but the demand for land soon outstripped all good sense. Several very wet years in the 1870s lead settlers to push north, following the mantra that also helped propel people further West in the United States: "rain follows the plow." The government encouraged these people on. Goyder was ridiculed.

The drought years of the late 1870s and 1880s put an end to those dreams. The farmers packed up and moved south and east

again, leaving behind ruined homesteads and ghost towns as monuments to their hopefulness and unrestrained confidence.

Their memory was short, however, and already by 1900 settlers had again moved their way north of the line, with predictable results of crop failure and destitution when the drought of 1914-17 hit. This time, however, the government stepped in to keep the farmers on this dubious land. The political pressures to find land for the growing population far outstripped the actual realities of sustainable crop cultivation.

The Engineers of Nature

As the dreams of the great inland river or sea desiccated in the failures of the Australian explorers—and as the truth of Goyder's line was made manifest—nineteenth-century advances in hydro-engineering once again fueled the Australian optimistic imagination and breathed new life into the water dreamers.

If an Australian Mississippi was not forthcoming, hope could be found in artesian groundwater and in the huge promise of irrigated agriculture.

Both of these required new technologies—machines to bore the ground for water and to build the dams and pipe systems to hold the water for irrigation—and trained engineers who would become the new high priests of nature change.

In these years, there was unlimited optimism in Australia that with these technological tools humans could transform and improve on what nature had provided. All too often, Australians believed, nature was inefficient and wasteful. Water often came at the wrong time, in the wrong quantities, and in the wrong places. Water that flowed through rivers to the sea was wasted. Every drop could and should be harnessed to human use. Droughts could be ended and floods controlled.

Artesian Waters

Over the nineteenth century, European settlers in Australia had noticed waters occasionally bubbling up from the ground—or more commonly had been led to these waters by Aboriginal guides. Now, with new drilling technologies coming in from Europe, the prospect of "unlimited" underground water gripped the settler community.

When drillers bored near Bourke in New South Wales in 1878, they stumbled upon the Great Artesian Basin, one of the largest groundwater supplies in the world (around 15,600 cubic miles of groundwater), which had been accumulating for millions of years. By 1915, more than 1,500 bores had been sunk in the Basin. The water flowed freely and seemingly endlessly, "bringing hope and comfort to the thirsty land again," as the famous bush poet Banjo Paterson wrote in his "Song of the Artesian Water."

Artesian waters opened thousands of square kilometers of arid, unproductive land for livestock. Adelaide, which had all but destroyed its nearby water supplies, was saved in the late 19th century by artesian water.

Water into Gold: The Alchemy of Irrigation

The faith in the power of civil engineering and human technology to improve on nature and to bring bounty to the population was even stronger in the case of irrigation and dam building.

As the nineteenth century progressed, it was becoming clearer to many settlers that water would need to be stored and regulated if agriculture was to have a chance to flourish and urban areas to receive a consistent supply of water.

There were years when the rains came nicely and Australians "forgot" earlier dry spells, but the intense drought years of 1877 and the 1880s convinced Australian capitalists and officials of the need for large-scale irrigation and damming.

While the necessity to combat drought was a driving force, there were also social, non-environmental reasons to work towards irrigated agriculture. Irrigation would build a more prosperous, populous, and egalitarian future for Australia. Opening up more land to farmers meant more opportunity for the poor, unemployed, and those without land. It would also allow more people to move to Australia, which was deemed necessary to defend Australia and to prevent Asian migration. And, of course, it would make some people rich.

Irrigation work began in earnest in the late 1880s, encouraged by the example of California. It started as a self-consciously private-capital venture, but by the early 20th century, state authorities stepped in to bail out failing irrigation trusts and take control of the irrigation process.

Much of this change in the relationship between water, irrigators, and state governments came under the watch of American Elwood Mead who stood as chairman of Victoria's Rivers and Water Supply Commission (1907-1915) and later would go on to head the U.S.'s Bureau of Reclamation (1924-1936, during which he oversaw the building of such massive dams as Hoover and Grand Coulee). Mead set up government supervision of the irrigation system and focused the irrigators on high-yield crops.

By the end of World War I, the process of damming the crucial River Murray was underway, spurred on by the memories of the Federation Drought. The planned dams and weirs took the next couple of decades to complete, but the resulting irrigation brought rapid agricultural development to the Murray-Darling Basin. Previously arid lands turned into highly productive fields—and diverse and remunerative produce was not only consumed at home but sent to the world market. Faith in irrigation to transform the future of Australia into a golden age only grew. The water

problem, it seemed in the early twentieth century, had been solved.

In 1937, for instance, to mark the 50-year Jubilee of the Australian Dried Fruits Industry, Ernestine Hill produced the unambiguously titled book, Water into Gold. The damming of the Murray and the irrigation of its surrounding land was not without its obstacles, but Hill described the process in unabashedly religious terms as a "miracle" carried out by "apostles."

"The River Murray to-day is a pageant of God's handiwork and man's," she acclaimed. "From the serenity of the snow mountains all the way to the Southern Ocean, the magic of irrigation has changed the face of Nature. There is a kingdom, a power and a glory of the Australia yet to be."

Not everyone climbed on the irrigation band wagon, however. Thomas Griffith Taylor, a professor of Geography at Sydney University after 1920, believed that large chunks of the continent were simply too dry for settlement, whatever the water boosters said. For Taylor, the "vast potentialities," that so many Australians saw in the arid lands, "only existed in the mind of the ignorant booster" who was mistaking "patriotism and rainfall."

This perspective was unwelcome, even unpatriotic, in Australia in the 1920s and his textbook on Australian geography was banned in Western Australia because he refused to take out the words "arid" and "desert" in describing Australia. As with Goyder before him, the dream of water repeatedly trumped the more sober and restrictive realities of hydrology.

A Country Dammed

Australia built three quarters of its more than 500 dams after 1945, decisively realizing the 19th-century dreams of hydrologic regulation. From the mid-1940s to the mid-1960s, Australia expanded by threefold the amount of its irrigated land. In the Murray and Murrumbidgee areas alone, the amount of land given over to irrigated rice cultivation increased from 15,000 to 110,000 hectares between 1950 and 1980.

The process of extensive water control and its development of agriculture in the Murray-Darling Basin has been a huge boon to the Australian economy. At their peak, these extensive irrigation works transformed 2.5 million hectares into some of the most productive land anywhere. In good years, Australia's 22 or so million people could produce enough food for 70 million people—and food exports became a cornerstone of the economy.

The Snowy Mountains Hydro-electric Scheme—one of the most remarkable feats of hydro-engineering in the twentieth century—now produces a significant component of Australian energy needs and directs more water into the River Murray.

By the 1980s, when dam building came more or less to a halt, the country's rivers and water systems had become among the most

regulated in the world. In the Murray-Darling Basin, only the Paroo River remains uncontrolled by human hand. The Murray became so regulated as to prompt some people to question whether it could still be considered a river at all.

Making the Drought Worse: The Balance Sheet of Water Control

The regulated hydrological structures created by Europeans since their arrival in Australia, along with their boundless faith in human engineering solutions, have made the effects of the current drought a great deal worse.

In the use of extensive irrigation Australians have focused their agricultural activities on highly lucrative, "thirsty" crops that require a great deal of water to grow. (In 2005-06, for instance, cotton alone used as much as 20% of all the water in the Murray-Darling Basin.) In exporting some of these profitable agricultural products, Australia ships off millions of tons of virtual water (the amount of water required to grow a certain food or manufacture a certain good). In recent years, Australia has exported as much as 430,000 tons of butter, cheese, and milk powder annually—the equivalent of shipping off 5.5 billion liters of valuable water.

As a result, Australia finds itself in the paradoxical position of having the lowest stream flow of any continent at the same time that, because of irrigation, it has by far the highest per capita level of daily water usage.

In addition, the schemes of water control that developed over the twentieth century have exacerbated the effects of the Big Dry by producing what many scientists call a "double drought."

Take the River Murray as an example.

Through damming and irrigation, the natural seasonal flow of the river has been turned upside down. Before regulation, the Murray "was really two rivers, a full surging river in the winter rising to a swollen flood in the spring, and a gentle docile summer-flow when the floods receded," in the words on one resident of Albury in 1981.

After regulation, the Murray has a more consistent flow, but the more plentiful winter rains are now released into the system in summer in order to irrigate crops. This 180-degree hydrological switch has created a human-made drought for the river and its flora and fauna.

According to renowned water scientist, the late Peter Cullen, "Australian aquatic ecosystems are adapted to drought, but between natural drought and man-made drought we've stressed systems beyond their normal capacity." They no longer receive the quantities of water, in the same quality, and at the same times of year as they did in the centuries before recent regulation.

Water from the dams evaporates more quickly than it would flowing down the river, so the amount of water available after regulation has declined. Moreover, water quality has deteriorated as the reduction in water during the swollen months means that various salts and other nutrients are not washed out.

And the impact of this human-made drought extends far beyond Australia, especially for birds whose migratory patterns tend not to respect national boundaries. Australia is the breeding ground for birds from as far away as Siberia. The drying of floodplains and the elimination of the annual flood has meant hard times for these birds, which affects distant ecosystems as much as local ones.

The problems of the current drought for the environment around the Murray have been made worse by problems of over-allocation of water. By the 1980s, as much as 90% of the river's average annual flow was legally committed to human use (especially agriculture but also industry and human water supply). The remaining ten percent was hardly enough for the flora and fauna to survive. Already in the 1990s, Australian state governments were making efforts to cap and control water usage from the Murray to a sustainable level.

To make matters worse, decisions about the allocation of water have been made since World War II, which historically has been a relatively wet period. As a result, not only have most of the waters in Australia's main rivers already been designated for some human use, but they have been designated based on assumptions about rainfall drawn from a wet period.

With the recent sharp drop in rainfall, the situation has arisen regularly where the legal rights of different humans to water are now greater than the volume of available water (and this is without taking environmental needs into account).

Climate Change

There is worrisome evidence that the Big Dry is also an harbinger of a more permanent shift in rainfall that results from global changes in climate—that it is something more than a hiccup in Australia's cycles of wet and dry and more than just a consequence of human water regulation.

In terms of temperature, the continent is clearly warming, with a 0.75 degree Celsius rise in the last 15 years, the result of which is more evaporation and less rainfall flowing through the rivers. The Great Barrier Reef—one of the most vibrant and productive ecosystems on the planet and the only non-human made structure of animal origin that is visible from space—is suffering and dying as a result of rising water temperatures and ocean acidification.

At the same time, a sudden and dramatic decline in rainfall in Perth since the 1970s also points to a more fundamental change in climate. From 1911-1974 the average inflow to the Perth dams

was 338 gigaliters; from 1975 to 2001, the average plummeted to 167 gigaliters; and it has dropped sharply again over the last decade. Similar "step changes" in rainfall have been noted elsewhere in Australia too.

In February of this year, scientists at the Australian Antarctic Division offered new evidence of climate change at work in the Big Dry when they published ice-core findings that show a link between higher precipitation in Antarctica and the drought in Western Australia.

"This does not appear to be in the range of natural variability," notes glaciologist Dr Tas van Ommen. "We can see from the ice core that an event like the increased snowfall [in eastern Antarctica] would only come along once every 38,000 years without some change in climate patterns and, given the connection we see with Western Australia, it would suggest that the drought is also not a natural event."

Many in the Australian government are beginning to agree. The report, "Climate Change 2009: Faster Change and More Serious Risks" warned Australians to prepare for the possibility of "recurring severe droughts." Penny Wong, Australian Minister for Climate Change and Water, declares: "Climate change is with us now, and unless we act now, it will only get worse in the life of our children."

Australians Confront the Big Dry

The ongoing crisis in Australia of water supply, allocation, and degradation has no easy answers.

When I asked Ben Gawne, Director of the Murray-Darling Freshwater Research Centre, what makes this drought different from others this century, he talked about how Australians historically have followed a "hydro-illogical cycle," where drought generates massive concern, search for solutions, and promises of change, all of which promptly disappear once the wet years return and water optimism again blossoms.

This time around, there are some indications that efforts at changing policy, economic structures, and ways of thinking may be more lasting.

Perhaps most importantly, Australians are moving beyond their water dreaming days. If, as historian Michael McKernan has written, "Indignant surprise was, until very recently indeed, the usual response to drought in Australia," there is now recognition that Australia is an arid and hydrologically variable continent; that there are climatic and environmental limits that must be respected if the country is to sustain itself in the long-term.

The drought has required a substantial rethinking of how water policy is developed and implemented. In particular, the central government and its agencies have taken on a larger role. In 2004,

the federal government unveiled the Australian Water Initiative; and in 2008 management of the Murray-Darling was handed over to a central agency, the Murray-Darling Basin Authority, which manages the Basin more holistically from a catchment viewpoint. The government has also legally redefined "drought" and now only offers aid under so-called "exceptional circumstances." At the same time, there has been an extensive effort to expand environmental education among school children.

Cities have renewed their efforts to develop alternative water sources—such as groundwater and desalinization plants—to complement the dams they currently rely on.

They have also endeavored to use the water that they already have more efficiently through ongoing conservation practices (such as dual flush toilets), Aquifer Storage and Retrieval (ASR) processes (to reduce evaporation), and extensive use of rainwater tanks. They are also focusing particularly on water recycling (use of waste water for watering gardens, agricultural use ("wine from sewage"), and in some cases for drinking). Many cities are now requiring a third pipe (marked purple) that brings non-potable water to houses for garden and toilet use (rightly noting the waste of flushing drinkable water).

These alternative water sources and efficiency measures are generally more expensive and more energy-needy than existing systems: desalinization, to take one, is often called "bottled electricity" for all the power needed. Prices for water will likely rise.

Australians are reformulating the way they approach the economics of water: from counting the actual cost of water—and the cost to the environment—in economic decisions to developing a water market, where rights to water allocations are bought and sold. Farmers too are being forced to change their agricultural practices to anticipate regular, prolonged dry spells.

Australians are also working extensively to repair the environmental harm that damming, regulation, and irrigation have done to their rivers and wetlands. Broadly speaking, the population accepts that only with a healthy environment can they expect a meaningful future. Vast government expenditures on the environment herald this commitment to nature.

In the case of the River Murray, efforts at river restoration and rehabilitation are combined in an ambitious recent program (2002) known as the "Living Murray," which "aims to achieve a healthy working River Murray system for the benefit of all Australians."

In addition, the Albury City Water Recycling and Management Program and the Wonga Wetlands offer an internationally renowned example of urban Australians trying to be more efficient with their water (through reclamation and re-use) and seeking improved environmental wellbeing through healthy wetlands and a return to natural river flow patterns.

In the case of Albury, the city now takes water from the Murray for the use of its citizens. The sewage and waste water is then taken through an advanced purification treatment plant and to a storage site. From there, the reclaimed water is released into the Wonga Wetlands and nearby areas during winter and spring when the surging river would naturally (before human regulation) have filled the wetland. Come summer, when the water would naturally have dissipated, the Albury water is sent down to irrigators to water their crops.

The project attempts to return a small corner of the river system to its natural flow regime, and to maximize water for multiple users. There is something curious in this reverse engineering process, of course, as it was human belief in their infallible ability to improve on nature that brought Australians to this problem in the first place. Yet, the results of Albury's current manipulations of water have been impressive. The floodplain wetlands are again beginning to thrive. Trees are returning to health, and fish and birds (many from far away) are returning to breed.

Perhaps more importantly than what is being done, however, is how hydro-social change is carried out. Australians have attempted as much as possible to take an inclusive approach to resolving these questions. On one level, many different types of knowledge are valued. Extensive scientific knowledge is integrated with policy expertise and local experience (especially of farmers and Aboriginal peoples, whose detailed understanding and long memory of the intricacies of the local environment are deemed crucial to decision-making).

On another level, there is an acceptance that the rights and needs of all stakeholders be respected and taken into account: including farmers and irrigators, urban Australians, industrial enterprises, the environment (with scientists and government officials as nature's proxy), and Aboriginal communities, for whom water is more than an economic resource, but also a cultural and religious legacy.

This does not mean that everyone will agree, of course, or that the pain of water shortage will be equally shared. But, there is a strong tendency to build "partnership." "That is the way we do it in Australia," says Adrian Wells of the Murray Darling Association, "We are all in this together."

Return of the Wet

"A Sunburnt Country …. Of droughts and flooding rains"
—Dorothea Mackellar (19th century)

In the months since this article was written, Australia's extremely variable, wet-dry climate has once again swung to the wet side of the spectrum, and with a record-breaking intensity.

Heavy rainfall and floods have struck many areas across the country, much as they have done at multiple times over the continent's history. In the 20th century alone, major floods

appeared in 1916, 1917, 1950, 1954-1956, and 1973-1975, with smaller or seasonal floods in other years.

This year, La Niña weather patterns have helped to bring these massive rains (in comparison to the dry years that tend to come with El Niño events).

For the past several weeks, massive and devastating flooding has hit the northeastern state of Queensland, made worse by the landfall of Cyclone Tasha in December. An area the size of France and Germany combined was turned into a vast inland lake, with muddy brown floodwaters and dozens of towns entirely under water. The floods have caused billions of dollars of damage and at least 25 deaths, in what some are calling the continent's worst natural disaster.

In Toowoomba, one of the hardest-hit areas, cars, trucks, livestock, and debris from homes and businesses were swept away in the ravaging floodwaters through the city center. In desperation, residents escaped to house and car roofs or clung to trees, hoping to be rescued.

More recently, the flood waters have surged through Brisbane, Australia's third largest city. They have reached their peak one meter shy of the vast 1974 floods (and about 4 meters lower than the largest flood peaks of 1893 and 1841). However, the damage is tremendous.

Entire neighborhoods are submerged and many in the city are without power. Many heartbroken residents will never be able to return to their homes, businesses have been washed away, and Queensland Premier Anna Bligh laments, "We now face a reconstruction task of postwar proportions."

"This is a truly dire set of circumstances," declared Australian Prime Ministers, Julia Gillard. It will be weeks and months before all the damage can be counted and all the missing people accounted for.

What a difference from little more than three years ago when the people of Brisbane were living under severe water use restrictions and being warned that the water for the city might soon run out.

Flooding has also struck the state of Victoria. A body of flood waters that stretch 90-kilometers in length (and over 3,000 square kilometers) is sweeping through the state, forcing thousands from their homes. Others are rushing to reinforce levees, protect houses and farms, and move livestock to safer areas from what one reporter called "a sea of putrid water." Most observers expect the flooding to continue for days more, with large pools of water surrounding communities for several weeks.

These floods are a much more intense variant of what hit Australia during the (southern) summer of 2010. Last year, parts of Queensland experienced record breaking floods, made all the worse by Cyclone Ului. The "best rain in years" fell through much

of the southern and eastern states. The flood waters made their way down the Darling and other rivers in the Murray-Darling Basin in what was called an "inland tsunami." The high degree of river regulation in the Murray-Darling Basin, though, did its job to control, capture, and store the surging torrents. The water last year filled up reservoirs for the first time in many years.

While devastating and heart-wrenching to human communities, the flooding serves very important environmental purposes: flushing out the river systems, spreading nutrients across floodplains, and watering the parched flora and fauna.

Over the centuries, animals and plants in Australia have adapted to boom-bust wet-dry cycles. Most species only reproduce when there is sufficient rain. Some invertebrates lay eggs that hatch at intervals, some after two or three heavy rains, just in case the first rain wasn't enough. The Sand Grasshopper's eggs can lay dormant in the soil for years waiting for rain. Kangaroos can maintain an embryo in diapauses; that is, freeze development until a drought passes.

When the water comes, the animals in Australia take advantage of the opportunity and breed very quickly. In the dry years, large stores of nutrients build up in the flood plains from the buildup of dead plant matter and when the water arrives, the continent witnesses one of the most explosive bursts of life anywhere—"the heaving, breeding morass," as one journalist for Australian Broadcasting Corporation called it. The waters become dense with fish, many of which are eaten by birds that also reproduce and flourish at this time.

Unlike the disaster of 2011, the floods in 2010 brought some relief from the drought to Australians and a growing optimism that the worst of the decade-or-so long "Big Dry" was behind them. As water returned to Lake Boga two years after it dried up, the community was "on an absolute high" of excitement. One politician from New South Wales called the rains "a return to normal."

Yet, both drought and flood, however severe, are normal to Australia's hydrologic cycles. The recent rains and flooding reinforce the persistence of Australia's long-term weather patterns of wet and dry cycles. Dry days will come again, as will wet ones.

The question of how to plan for and respond to these ongoing cycles of wet and dry continues to confront Australians, just as it has challenged them throughout their history.

Will the changes—to policy, economy, agriculture, lifestyle, and ways of thinking about water in Australia—begun over the past twenty years or so continue on? Will the debate over Australian water policy and usage become more heated or will the dry days fade from memory?

Overshadowing these questions as Australians move forward is the pressing problem of climate change. While La Niña weather

patterns are the immediate cause of this year's flooding, many scientists and policy-makers wonder whether the severity with which the floods have hit Australia (and elsewhere on the planet this year) are the result of changes in the climate.

As Britain's Royal Geographical Society's Geographical magazine recently reported, evidence is quickly mounting that we are living through a fundamental climate shift that is making the world's weather patterns more extreme.

Whatever the answers, how Australians approach their water will remain an unavoidable and essential question for the country as it moves into the future. And those around the world interested in humanity's use of water will continue to watch Australia closely. ◆

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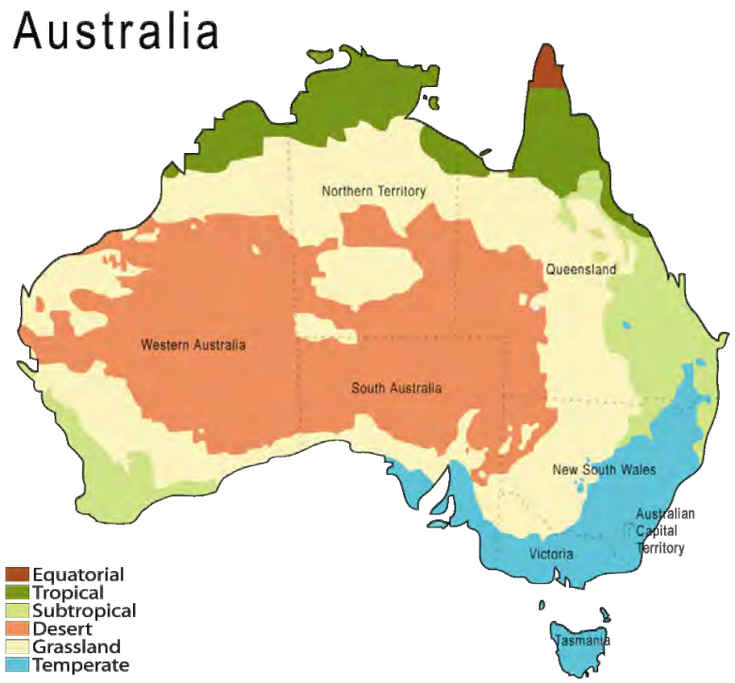
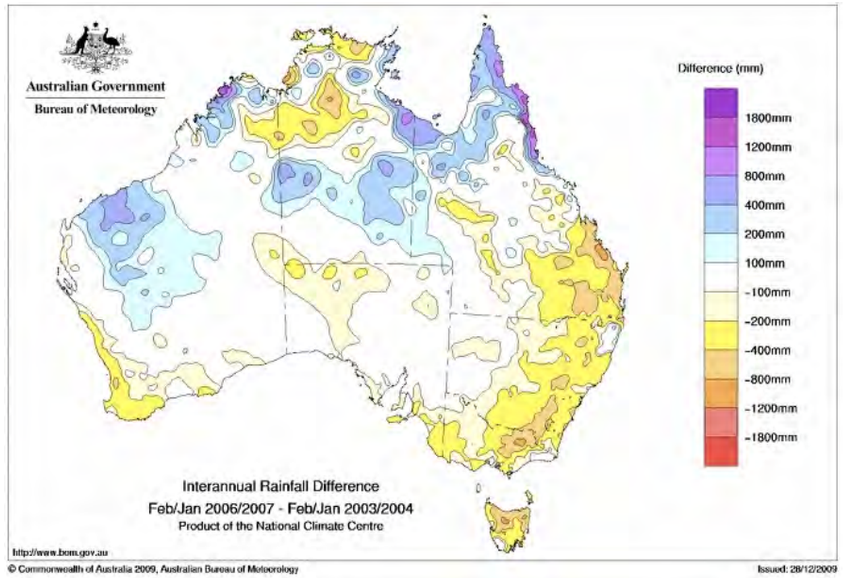
Maps and Charts

A Climate Map of Australia



(Source: Australian Bureau of Meteorology)

Map of Australia showing the Three Year Difference in Rainfall Totals, 2004-07 (

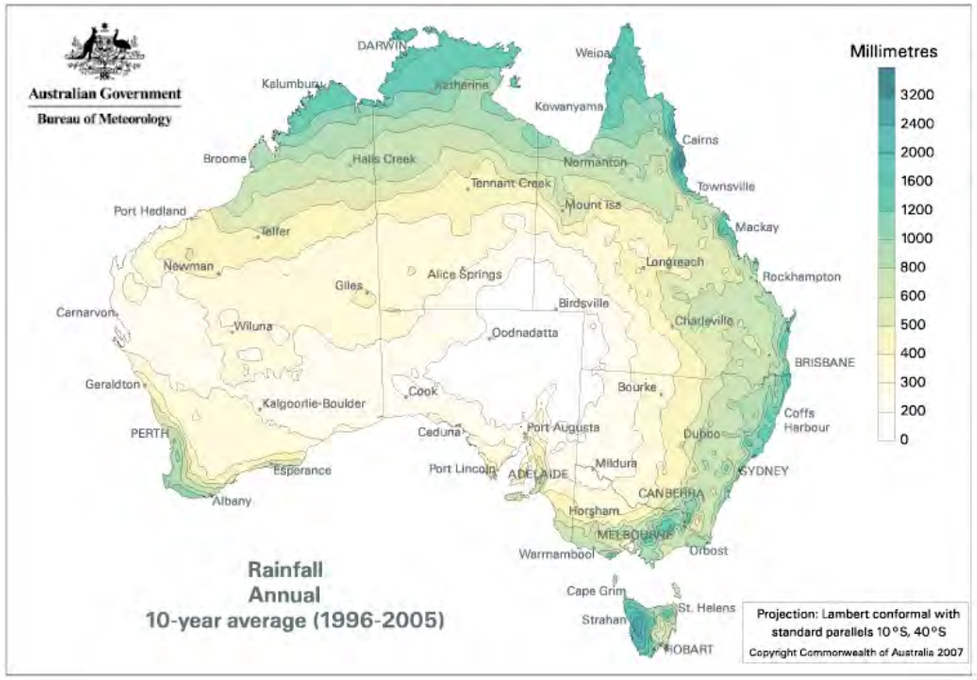


(Source: Australian Bureau of Statistics)

Map of the Murray-Darling Basin

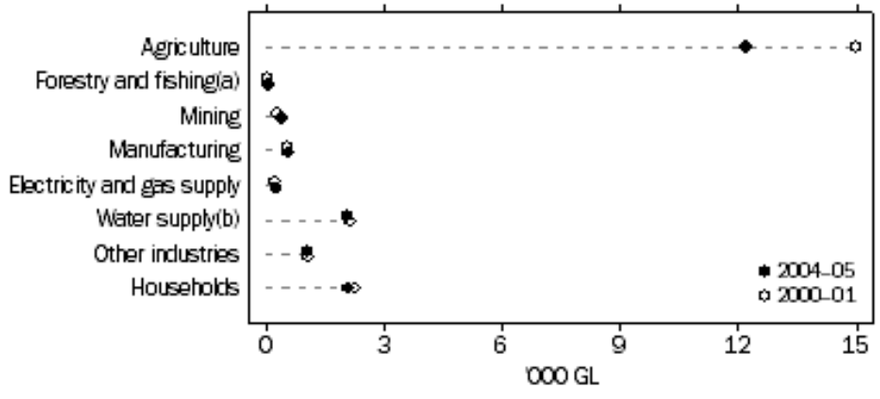
(Source: Wikipedia)

Map Showing the Average Rainfall in Australia, 1996-2005.



(Source: Australia Bureau of Statistics)

Water Usage in Australia between 2000-01 and 2004-05 per 1000 gigaliters, noting the predominance of agricultural



(a) Includes Services to agriculture; hunting and trapping. (b) Includes Sewerage and drainage services.

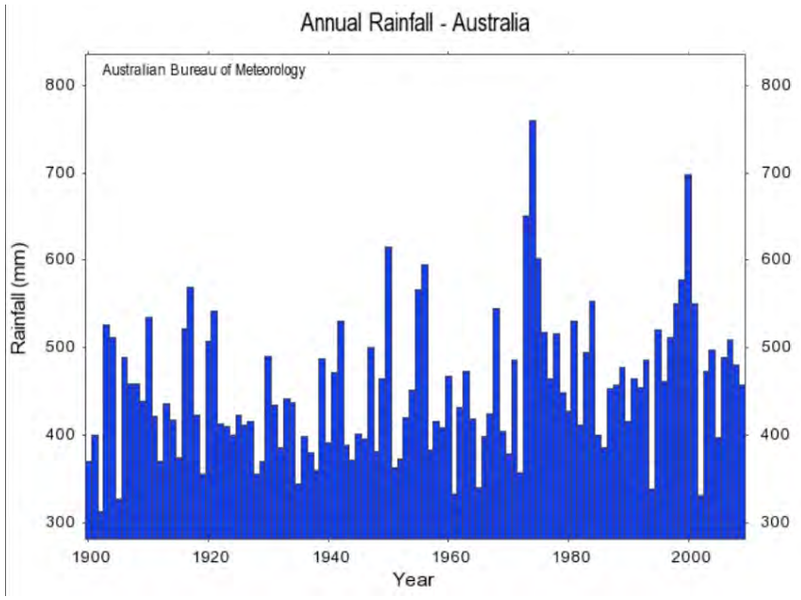
Source: Water Account, Australia (4610.0).

(Source: Australian Bureau of Statistics)

Map of Wildfires in Victoria on February 7, 2009; "Black Saturday"

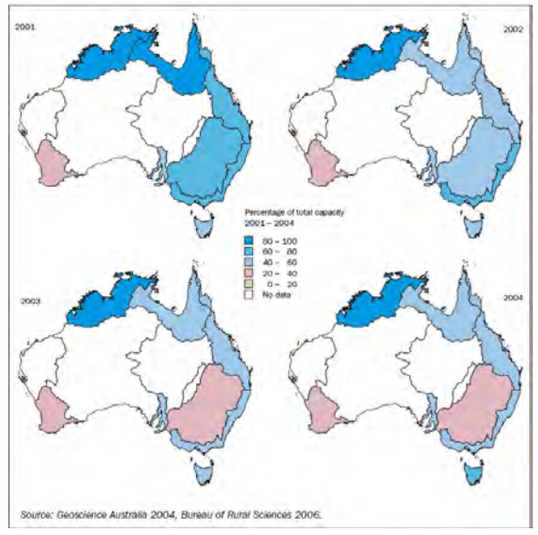
(Source: Wikimedia Commons)

Annual Rainfall in Australia



(Source: Australian Bureau of Meteorology)

Maps showing Dam and water capacity in Australia in the 2000s



(Source: Australian Bureau of Statistics)

Additional Images

A Billabong at Yellow Water in Kakadu National Park in Northern Territory

(Source: Tourism Northern Territory)

Artificially flooded wetlands in Hattah Kulkyne National Park, July 2009. They were flooded in an effort to recreate natural water flows

(Source: Author-Nicholas Breyfogle)

Artesian Bore Drilling Plant in Queensland, 1900

(Source: John Oxley Library)

Apparatus to separate artesian water from natural gas, 1900s

(Source: John Oxley Library)

Alfred Deakin (3 August 1856 – 7 October 1919), Australian politician, was a leader of the movement for Australian federation, the second Prime Minister of Australia, and a major player in establishing irrigation in Australia.

(Source: Public Domain)

Aerial view of Nangiloc, Iraak and Colignan during the 1956 Murray River Flood

(Source: Public Domain)

A Fish Ladder at Torrumbarry Weir, River Murray

(Source: Author-Nicholas Breyfogle)

Artificially flooded wetlands in Hattah Kulkyne National Park, July 2009. This was an effort to preserve environmental health during the drought

(Source: Author-Nicholas Breyfogle)

Center Pivot Irrigation near Euberta in the Riverina region of New South Wales

(Source: Creative Commons, by Virtual Steve)

Captain Charles Napier Sturt (28 April 1795 – 16 June 1869)-- an English explorer of Australia who led several expeditions into the interior. He found that all east-west rivers merged into the Murray River as he searched for an "inland sea".

(Source: Public Domain)

Cliffs along the Murray River, near Younghusband, South Australia, with a Houseboat on the Right and an Australian Pelican in the Foreground

(Source: Wikipedia)

Dead/Dying River Red Gum Trees on the lower Murray River near Berri, South Australia, 2003

(Source: Creative Commons by Scharks)

Drought-affected Fields in the Victorian Countryside outside Benambra

(Source: GNU license by Flagstaff Fotos)

Diesel Water Pump for Irrigation in Mildura, Victoria

(Source: Creative Commons by Longhair)

Elwood Mead, American Chairman of Victoria's Rivers and Water Supply Commission

(Source: Public Domain)

Flood marker on the River Murray, with the peak marking the high point of the 1956 flood

(Source: Author-Nicholas Breyfogle)

Grapevines in Mildura, Victoria, 2006

(Source: Public Domain by Longhair)

Hot water bore hole into the Great Artesian Basin in Thargomindah, April 2007

(Source: GNU by Kdliss)

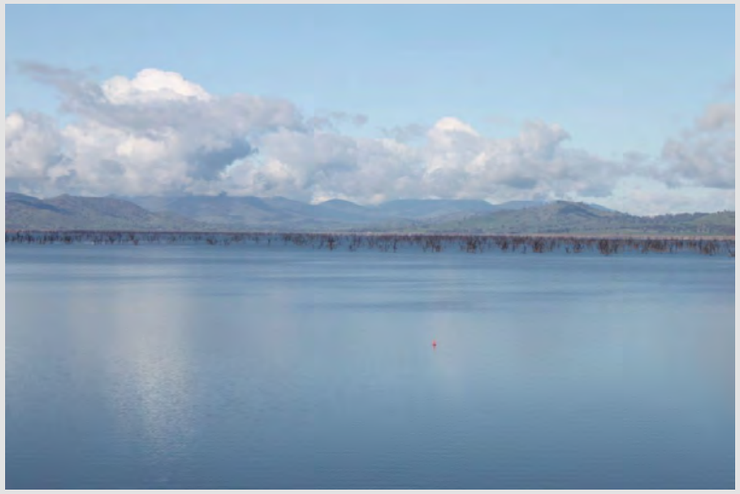
Flood markers at Lock 11 in Mildura. The second highest red marking is where the river reached in 1956

(Source: Creative Commons by Longhair)

Hume Dam

(Source: Author-Nicholas Breyfogle)

Hume Reservoir now showing a forest that was submerged when the Hume Dam was built, July 2009



(Source: Author-Nicholas Breyfogle)

Little Sandy Desert near Durba Spring, 2007

(Source: GNU by Peter WH)

Hume Reservoir water level marker, showing the significantly reduced level of water, July 2009

(Source: Author-Nicholas Breyfogle)

River Murray near Barmah-Millewa Forest, July 2009

(Source: Author-Nicholas Breyfogle)

Pumping Machinery to bring water from the River Murray to flood wetlands in the Hattah Kulkyne National Park, July 2009

(Source: Author-Nicholas Breyfogle)

Pejar Dam, the Water Supply for Goulburn, New South Wales, in November 2005

(Source: Creative Commons License by AYArktos)

Moree Water Bore in New South Wales, 1898

(Source: John Oxley Library)

The Wonga Wetlands, Albury, a successful effort to recreate seasonal flooding and heal damage done to the local environment through river regulation, July 2009

(Source: Author-Nicholas Breyfogle)

The Paroo River at Wanaaring, New South Wales, Australia, July 2001

(Source: Creative Commons by Peter Woodard)

The Dry Bed of the Paroo River near Wilcannia, May 2002

(Source: Creative Commons by Peter Woodard)

Water trough on a sheep farm 50km north of Deniliquin, New South Wales

(Source: GNU License by Virtual Steve)

Tempini Orchards near Lake Boga, trees grown on reclaimed saline land, July 2009

(Source: Author-Nicholas Breyfogle)

A Canoe Tree. More than 100 years ago, the native peoples of the region carved a canoe from the bark of this tree

(Source: Author-Nicholas Breyfogle)

A Farmer Feeding Cattle Cotton Seeds in New South Wales during a green drought

(Source: GNU license by CGoodwin)

Section 5

A Tale of Two Fisheries: Fishing and Over-Fishing in American Waters

EDITOR'S NOTE:

Not too long ago, we viewed the oceans as an inexhaustible resource. Now, from the Gulf of Mexico to the Baltic, from the Mediterranean to the South China Sea we find our oceans struggling, in some cases dying. Destructive fishing practices, pollution, "dead zones" from industrial and agricultural run-off, ocean acidification from CO2 emissions, and coral reefs suffering from the effects of global climate change are challenging the health of the oceans in unprecedented ways. It is an environmental disaster, of course, but also an economic one. All in, the value of goods and services derived from the world's oceans reaches US$21 trillion annually. This month, Ohio State historian Mansel Blackford discusses the problem of collapsing fish stocks. Looking at the very different histories of two American fisheries, he explores how best to manage our ocean resources.

Published 2008.

By **MANSEL BLACKFORD**

An Alaskan fisherman holds up part of his catch, a large Alaskan King Crab. As successful catches became more costly and less efficient, fishing areas around the world entered a new era of global and national management. (Source: author)

In the spring of 2007, the author of an introduction to three essays in *National Geographic* warned, "The oceans are in deep blue trouble. From the northernmost reaches of the Greenland Sea to the swirl of the Antarctic Circle, we are gutting our seas of fish. . . . Nets scour reefs. Supertrawlers vacuum up shrimp. Nations flout laws."

There are valid reasons for concern. Numerous scientific reports have thoroughly documented the extent of over-fishing. Despite a growing awareness of the problem and efforts to address it by government officials and fishers alike, fish stocks around the globe have collapsed, most dramatically during the 1980s and 1990s.

As a result, Americans and other people around the world have watched as some of their favorite types of fish disappear from their dinner tables—North Atlantic

Picture of Fisherman's Terminal in Seattle, WA. (Source: Wikipedia)

cod, swordfish, and blue-fin tuna, to name a few—to be replaced by others, such as wild Alaskan salmon, pollock, Pacific cod, and sablefish.

There have been many efforts globally to address the over-fishing crisis, some more successful than others. Two American fishing regions highlight the pitfalls and possibilities of a sustainable fishing industry.

In the waters off New England, we see a marked failure to regulate bottom-fish catches. Fish stocks disappeared and along with them the livelihood of fishing families, some of whom had been in the business for generations.

Yet, far across the continent the Alaskan Pacific fisheries have succeeded in regulating the amount of bottom fish and, to some extent, salmon and crab taken from the water. It was no coincidence that when Atlantic fish disappeared from American meals, Pacific fish took its place.

However, even successful practices of sustainable harvesting are not without their own problems. Alaska's approach to fishing may have replenished fish stocks, but along the way it has also raised important questions of environmental justice. Debates have been fierce over who will benefit and who will lose out from these efforts to preserve fish stocks and the fishing industry.

Conservation, the fishing story tells us, is never easy.

The Over-Fishing Crisis

During the nineteenth and twentieth centuries, innovations in fishing and improvements in transportation helped fishers boost their catches—and consequently sales of seafood—enormously.

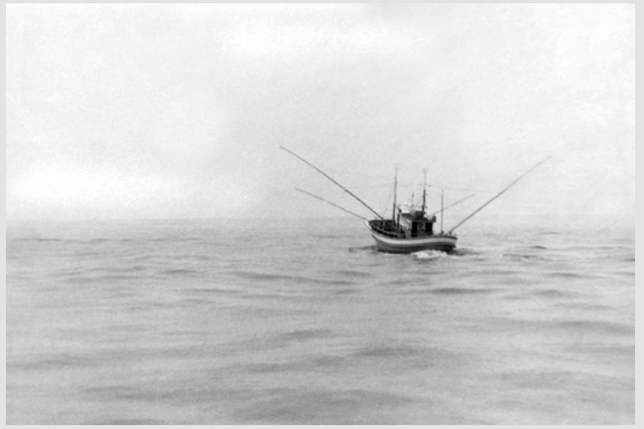
Large-scale, "industrial" fishing can be traced back to the 1870s and 1880s, when fishers started trawling with steam-powered vessels in British and European waters, such as the North Sea. At about the same time, railroads connected fishing ports to interior towns, increasing markets for fish.

Having depleted inshore and near-shore fishing grounds, steam trawlers fished far from their home ports by the 1920s and 1930s. Steam-powered trawlers came to dominate Canadian and American cod fisheries, and fast-freezing techniques, introduced to some fisheries at the same time, further extended operations.

The decades after the Second World War saw a tremendous expansion and intensification of global fishing. New, long-distance fishing and processing vessels stayed at sea for months at a time.

Seabirds accompanying a longline fishing vessel. (Source: National Oceanic and Atmospheric Administration)

There was great optimism that off-shore fishing would provide the peoples of the world with much-needed protein at reasonable costs. In the 1950s and 1960s, some scientists estimated that the oceans and seas could sustain an annual seafood catch of 200-350 million metric tons per year, more than twice as much as was ever actually achieved. (A metric ton is 1,000 kilograms or 2,204 pounds.)



Trolling for Tuna in the North Atlantic. (Source: National Oceanic and Atmospheric Administration)

Popular movies such as the 1954 production of Jules Verne's "20,000 Leagues beneath the Sea" featured divers harvesting seemingly inexhaustible riches from seas and oceans. This tremendous optimism about oceanic resources rivaled that expressed about nuclear power and space at about the same time.

A global over-fishing crisis soon developed. Between 1950 and 1995, the global wild fish and shellfish catch soared from 19 to 94 million metric tons, a level it has maintained to the present day. The global catch stagnated after 1995, however, despite a tremendous intensification in fishing efforts. The fish cornucopia had disappeared.

Between 1970 and 1995, the number of fishing vessels worldwide increased from 451,000 to 885,000 and their aggregate size rose from 12 million gross registered tons (grt) to 82 million grt. (A gross registered ton is a measure of storage space equal to one hundred cubic feet.) [click to see chart: ' Global Capture Production, 1950-2005'] An increasing proportion of these ships

were fast diesel- and gasoline-powered vessels, which were much more efficient than earlier ships in catching fish.

The ships used a broad array of sophisticated technological devices such as radar, sonar, loran, and Global Positioning Systems to find fish. They then caught fish with lines up to sixty-two miles in length, strung with tens of thousands of hooks. They dragged huge trawl nets across the ocean bottom, often "clear-cutting" the ocean floor in the process. By the 1990s a single trawl net might be large enough to hold a fleet of twelve Boeing 747 jumbo jets. And they deployed gigantic purse-seine nets made of light but strong synthetic fibers.

In 2007, one respected marine biologist summed it up: "The twentieth century heralded an escalation in fishing intensity that is unprecedented in the history of the oceans, and modern fishing technologies leave fish no place to hide."

Soon, fishing for many species got harder. The intensity of fishing for wild fish and crustaceans increased substantially faster than did the size of the fishing catch after 1970. More ships with better equipment made smaller catches per unit of effort. Profits became less assured for many fishing companies beginning in the 1970s and accelerating in later decades.

U.S. Coast Guard Cutter Boutwell enforcing fishing laws through the North Pacific Coast Guard Forum in 2007. (Source: Department of Defense)

Regulating Ocean Fishing

Beginning in the late 1950s and early 1960s, the United Nations, along with certain countries and organizations, began efforts to regulate fishing internationally. However, little was really accomplished until the 1970s, when many nations declared 200-mile exclusive economic zones (EEZs) out from their shorelines.

Authors of the EEZs were building on earlier United Nations Law of the Sea Conventions, which gave coastal nations control over the exploitation of their continental shelves. They were trying to ensure that ocean resources would be retained for their own

citizens. Many were also interested in making fishing within their EEZs sustainable by placing limits on fish catches.

Alaskan fisheries expert Terry Johnson recently called the EEZs "the most profound change in the world's commercial ocean fisheries." By 2000, EEZs had brought about one-third of ocean waters and 75-90 percent of the globe's commercial fish under national controls.

Fishing trends for wild species in American waters were similar to those in many other regions of the globe. The number of fishing vessels plying North American waters jumped from 17,700 in 1970 to 42,500 in 1995, and during the same period their tonnage increased from 947,000 to 2, 217,000 grt. American fish landings rose from about 2.5 million metric tons in 1950 to a peak of 5.6 million metric tons in 1987, before slipping to 5.3 metric tons in 1995, and to just 5 million metric tons in 2004.

The United States proclaimed an EEZ in 1976 with the passage by Congress of the Federal Fishery Conservation and Management Act (FCMA), reenacted with some changes in 1996. This legislation extended the federal government's control over oil, minerals, and fish 200 miles out to sea. Basically, it banned foreign fishers from American waters.

The United States set up eight regional management councils to administer Total Allowable Catches (TACs) for different types of fish in their areas. TACs were often divided among established fishers by giving them individual transferable quotas (ITQs), thus virtually vesting them with property rights in their fish stocks. The ITQs usually gave fishers rights to a certain percentage of the annual catch of specified fish stocks.

The use of TACs and ITQs sought to avoid a "tragedy of the commons" in fisheries. In commonly held oceanic resources, there is little motivation for conservation. If one fisher voluntarily refrains from taking as many fish as possible, another fisher—lacking any legal or moral restraints on his or her actions—might well take those fish; even if doing so means that a fish stock might be greatly reduced in size.

The FCMA, as revised and renewed in 1996, required that the nation's eight fishery management councils devise ten-year plans to rebuild depleted fisheries. The plans were often unsuccessful in their charge, however. A survey of 300 major fish species completed in 1998 by the U.S. Marine Fisheries Service showed that 90 were over-fished, 10 were approaching that condition, and 200 were healthy. In 2006, the news was worse. A new survey revealed that 82 percent of the major fished stocks in American waters suffered from over-fishing.

Even so, the situation was and remains complex, varying by locale and by fish stock. Attempts to regulate the taking of bottom fish (especially Atlantic cod) in the Northwest Atlantic in the interests of sustainable harvests have largely failed. On the other hand, the regulation of fishing for salmon, crab, pollock,

halibut, Pacific cod, and sablefish in the Northeast Pacific has been more successful.

Disappearing Cod and the North Atlantic

The Northwest Atlantic cod fishery is a particularly disastrous example of the results of treating the ocean as a nearly unregulated commons for too long. Commercially exploited from the 1500s, the Northwest Atlantic cod fishery—centered on the Georges Bank off Maine and the Grand Banks off Nova Scotia—yielded about 250,000 metric tons of fish annually in the seventeenth through the nineteenth centuries, causing some local depletion.

The fishing of cod in Newfoundland in 1858--manufacturing of cod oil. (Source: Wikisource)

Cod came under greatly increased pressure with the advent of long-distance trawling and processing vessels in the twentieth century, especially in the mid-1950s. By 1965, the Soviet Union alone had 106 factory trawlers and 425 smaller trawlers supplying 30 mother ships (processing vessels) in these waters.

The total Soviet catch in the Northwest Atlantic came to 886,000 metric tons that year, including 278,000 metric tons of cod and haddock, another bottom fish. Nine years later, 1,076 Soviet and Communist-bloc fishing vessels extracted 2,716,000 metric tons of fish from the banks, ten times the size of the catch taken by American fishers and three times that of Canadians.

After the passage of the FCMA in 1976 and the enactment of similar legislation by Canada's legislature, the Georges Bank and most of the Grand Banks were off-limits to the Spanish and British, who had long fished these grounds, as well as to newcomers, such as Soviet and East German fishers.

However, this situation did not lead to sustainable fishing. American fishers, working through the New England Fishery Management Council (NEFMC, one of the United States' eight regional management councils), and Canadian fishers, working

through a fishery agency of their national government, simply replaced the foreigners. In an effort to create jobs for people in seaside communities that had few alternatives to fishing, both governments urged the fishing on with low-interest loans available for the construction of new fishing vessels (this provision was part of the FCMA).

Intense fishing pressure continued, as both Canadian and American management bodies—composed of government officials and fishers—set TACs that were much too high to be sustained. Over-fishing led to a crash of cod fisheries in the American and the Canadian EEZs.

The loss was tremendous. A leading American fisheries trade journal observed, "After the U.S. fleet eventually geared up, it took up where the foreign fleets had left off, especially in the Northeast. By the mid-1990s, catches of bedrock species like Atlantic cod had plummeted from more than 40,000 metric tons to about 10,000 metric tons," making cod "a cause célèbre."

In 2002, northern cod populations off Newfoundland were less than 0.5 percent of what they had been as late as the 1960s. Despite closures of the Georges Bank and the Grand Banks in the early and mid-1990s, cod did not rebound in population. On the contrary, they suffered an additional one-quarter drop in their population between 2001 and 2005.

Widespread job losses and partial depopulation occurred in cod-fishing regions facing the Atlantic. Most hard-hit was Newfoundland. The province's population fell 2.9 percent between 1991 and 1996, and by 1997 some 30,000 of the province's 570,000 residents were unemployed, mainly due to the closing of the over-fished cod industry.

The Alaskan Success Story

Many studies have decried the destruction of oceanic resources and especially over-fishing, including that of the cod of the Northwest Atlantic. Much less has been written about successes in regulating bottom fish, salmon, and (perhaps) crabs in Alaskan waters.

Nowhere has the use of TACs and ITQs gone farther than in Alaskan waters. Nowhere have they been more successful in making fisheries sustainable. Nowhere, however, have TACs and ITQs raised more environmental-justice concerns. Indeed, this dramatic success story was not achieved easily or without social costs. What has happened in Alaskan fisheries over the past two decades illustrates well major issues people across the globe face in dealing with their natural resources.

As catches for fish and shellfish fell in other American waters, Alaskan fisheries grew in relative importance. By the early 2000s, Alaskan waters accounted for about one-half of the seafood caught in the United States. The dockside value of Alaska's

Commercial Fishing in Alaska in the 1920s. (Source: Library of Congress)

seafood harvest came to about $1.4 billion annually, and the state's seafood industry employed about 70,000 people.

Bottom fish composed the most important segment of the catch, surpassing even salmon and crabs in value. Many of the fish stocks were being exploited on a sustainable basis and were, noted one seafood journal, "in excellent shape."

Boats taking bottom fish had worked Alaskan waters for a century by the 1970s and 1980s. However, with over-fishing either an increasing reality or a threat, depending on the exact species, new management methods were developed in the 1990s and early 2000s. The North Pacific Fishery Management Council (NPFMC)—like the NEFMC one of the regional bodies set up by the FCMA—set the rules for fishing in the offshore waters of the Pacific Northwest and Alaska.

The NPFMC began regulating the take of bottom fish in Alaskan waters in the late 1970s and early 1980s. The council allocated TACs for bottom fish solely to American fishers in 1990, excluding foreigners and joint ventures. ITQs, which went only to well-established fishers, were added for halibut and sablefish in 1995-96, although not for Pacific cod or pollock. (Halibut were managed jointly with Canada through the International Pacific Halibut Commission.) In the mid-1990s, too, a moratorium was placed on the entry of new vessels into the bottom-fish industry.

The NPFMC devised even more far-reaching provisions for Alaska's important

Crab Boat Deck in Alaska. (Source: author)

crab industry. In fact, few industries in the United States have ever been as highly regulated as the crab industry became. Because of over-fishing and, perhaps, natural environmental changes in Alaskan waters, Alaska's crab catch plummeted from 400 million pounds in 1991 to just 45 million pounds in 2000.

As a result of this drop, members of the NPFMC considered new ways to regulate the crab catch in 2001, and decided that a rationalization plan based on seasonal TACs and ITQs was more desirable than other alternatives. After holding numerous public hearings and modifying its original scheme, the NPFMC achieved rationalization with a plan implemented in 2005. The goal of this system was to stabilize Alaska's crab industry in the interest of making fishing sustainable and profitable.

Fishery officials set TACs for various crab species each fishing season. Those officials issued long-term ITQs (called Individual Fishing Quotas or IFQs in the Alaskan crab industry) to fishing boat owners. IFQs were guaranteed shares of the TACs, with the assumption being that the boats could actually catch the crabs. Processors, in turn, were guaranteed specific shares of the catch to freeze or can (these were called Individual Processing Quotas or IPQs).

The NPFMC divided the Bering Sea and Aleutian Island fisheries into eight districts and required that fishers deliver 90 percent of their crabs on a set schedule to designated processors in their districts. Representatives of arbitration organizations for fishers and processors determined prices for crabs at the start of each fishing season, with binding arbitration mandatory to break any deadlocks.Only those boat owners and processors who could show that they had been commercially active in Alaska's crab industry for a number of consecutive years—four or five years for fishers and three or four years for processors, according to their districts—received IFQs andIPQs.

Defined by the NPFMC as "Eligible Crab Communities" (ECCs), nine communities dependent on crab fishing also received some guarantees that fishers and processors in their communities would receive quotas.

In 2008, the jury is still out on how well the crab-rationalization plan has worked. It certainly led, as expected, to consolidation. The number of boats fishing for crabs fell from 357 to 80, and the number of crew members dropped from roughly 1,500 to just 400.

Conservation is another matter. Whether the crab catch will recover remains in doubt. Several crab-fishery areas have been closed. The TAC for king crabs was lowered 15 percent in 2007 to encourage recovery, and the American catch that year came to only 15.5 million pounds.

The Fishers' Lament

Fishers voiced many concerns as the NPFMC ended open access to Alaska's fisheries. Only established boat owners with ITQs could fish. Many women, who made up about 5 percent of the fishers in Alaska, and Alaskan Natives were left out. These two groups have had a harder time becoming boat owners because they have a more difficult time securing credit. Only a few boat captains and no crew members were guaranteed places in what was a shrinking group of fisheries participants.

These changes caused considerable dissatisfaction, especially in the crab fishery. In mid-2007, the trade journal *Seafood Business* noted: "In the Alaskan crab fishery, the fleet has been reduced by two-thirds, much to the dismay of Alaskan fishermen and crew members who didn't make the cut. The few who did, though, now have plenty of money to hire lobbyists."

Community-development concerns have arisen as well. Rationalization resulted in entire communities—except those nine designated as ECCs—being excluded from crab fishing. An anthropologist who studied the impacts of the crab-rationalization program on communities in the Aleutian Islands concluded, "The findings on direct impacts of crab rationalization on the study communities include loss of crab fishing crew jobs, fewer boats delivering crab, and lower sales for support businesses."

Some fishers were outspoken. "All those boat owners ended up with this quota and it was built by guys like myself; guys that were on deck all those years—they didn't get anything out of it." Another observed, "It was put together by a group of too many special interests which captured the fishery for themselves; it had nothing to do with the people that participated."

In April 2008, Terry Haines—a Kodiak city councilman, former deckhand, and member of Fish Heads, an advocacy group concerned about the impact of rationalization on communities—complained: "In the years since implementation of crab rationalization the council [the NPFMC] has done very little to look back at what happens to towns like Kodiak when you tie up two-thirds of the boats, suck 75 percent of the money out of the paychecks and make the free market illegal."

Even some boat owners who possessed IFQs lamented that their earlier free-and-easy way of life was vanishing, a victim of rationalization. Bart Eaton, a longtime king-crab fisherman, later a vice president of a major seafood processor-wholesaler, asked: "Do we really want a failsafe society? With regulations that tell you where to fish and when, guys feel more and more like they're spare gear in a big bureaucratic machine."

One captain and boat owner explained in 2008, "We are afraid of becoming hourly salaried workers with the adventure, traditions and romance of crabbing buried under pages of quotas and regulations. We do not want to be part of bureaucracy." He

concluded, "The Bering [Sea] then is our last frontier. It is our Wild West, our *Lonesome Dove*, played out on waves."

Responding to community concerns and to changes in the FCMA, the NPFMC instituted a Western Alaska Community Development Quota Program in 2006-2007, which allocated "a percentage of all Bering Sea and Aleutian Islands quotas for groundfish, prohibited species, halibut, and crab to eligible communities."

Continued questioning led the NPFMC to review its crab-rationalization plan in early 2008. Members considered various ways by which "some community concerns could be alleviated." They recognized, too, that "the benefits received by shareholders [those having IFQs] . . . have been at the expense of crew more than others" and that "the current program lacks mechanism for natural progression of crew in fishery from deck to wheelhouse to vessel ownership."

Meanwhile, the state of Alaska and several private banks implemented programs to help individuals and communities acquire fishing quotas, through the formation of fishing cooperatives, for example. How successful they will be remains to be seen.

The Tale of Two Fisheries

The different fates of the American fisheries in the Northwest Atlantic and Alaska reveal complexities in fishing and over-fishing.

Over-fishing has been most common in the long-established fisheries of the Northwest Atlantic, such as those for cod and blue-fin tuna. The application of industrial fishing methods after the Second World War intensified large-scale fishing that had begun much earlier. Americans and Canadians finished the over-fishing begun by others. The failure of the NEFMC [New England Fishing Management Council] and international bodies to provide adequate regulation made an already bad situation worse, leading to the near-demise of Atlantic cod and blue-fin tuna as commercial fish stocks.

Farther north in Alaskan waters, regulatory results were mixed, but generally more positive. Crabs suffered from over-fishing, an initial lack of adequate regulation by the NPFMC, and ecological changes. Even with the implementation of a rationalization plan, the future of crab fishing is uncertain. Rationalization plans do seem to have placed fishing for major commercial species of bottom fish on a sustainable basis. Pacific cod are not going the way of their Atlantic cousins.

Alaskan success has been recognized internationally. By mid-2008, the Marine Stewardship Council, a well-respected British environmental body, had certified only twenty-six fisheries

around the globe as being conducted in sustainable ways. Impressively, this small list included all Alaskan pollock, salmon, halibut, and sablefish, and most Alaskan cod. The only other American fishery to achieve such status was Oregon pink shrimp.

The different outcomes of New England and Alaska are explained by certain advantages that members of the NPFMC had over their counterparts in the NEFMC [New England Fishing Management Council]. The Alaskan management council had access to more advanced scientific information—a major reason the NEFMC [New England Fishing Management Council] failed is that marine science did not always provide it with reliable information. The NPFMC also had generally younger, more adaptable fisheries. It also could learn from the cautionary tale of what had happened to the Northwest Atlantic cod.

From bonanza, open-access industries, in just a generation most of Alaska's fisheries have become among the most highly regulated industries in the United States.

In Alaska, the need for stability and permanence trumped earlier desires for quick gains and big bucks, making most of the state's fisheries sustainable, but also limiting opportunities for some individuals and entire communities. Such trade-offs, it is likely, will become increasingly common in a world of scarce natural resources. ◆

Abbreviations and Acronyms

ECC: eligible crab community

FCMA: Federal Fishery Conservation and Management Act

NEFMC: New England Fishery Management Council

NPFMC: North Pacific Fishery Management Council

IFQ: individual fishing quota

ITQ: individual transferable quota

IPQ: individual processing quota

TAC: total allowable catc

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Johnson, Terry. *The Bering Sea and Aleutian Islands*. Fairbanks, 2003.

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Safina, Carl. *Song for the Blue Ocean.* New York, 1997.

Woodward, Colin. *Ocean's End*. New York, 2000.

Maps and Charts

North America, showing the Northwest Atlantic and Northwest Pacific

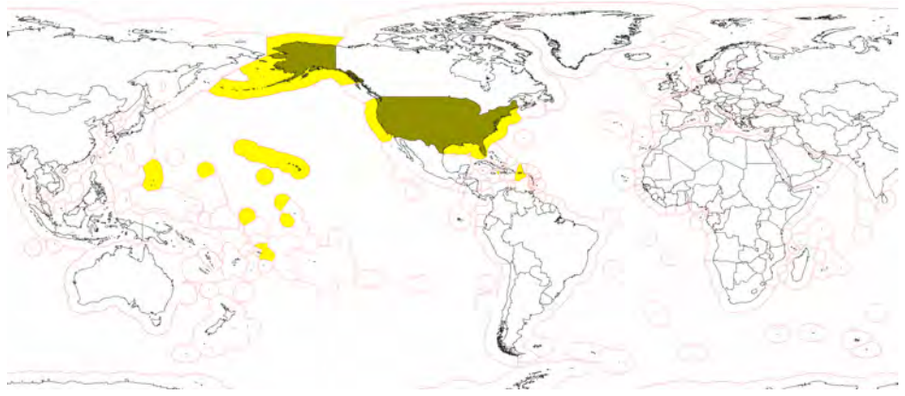
(Source: University of Texas Libraries)

Chart that shows sizes of catches and number of ships.

Date	Global Wild Fish/Shellfish Catch Millions of Metric Tons	Number of Fishing Vessels Global Total	Number of Fishing Vessels North America	Tonnage of Fishing Vessels Millions of Metric Tons	Tonnage of Fishing Vessels North America/Metric Tons	Date
1950	19					1950
1960	35					1960
1970	64	451,000	17,700	11.6	947,300	1970
1980	68					1980
1985	68	587,000	35,300	17.5	2,217,200	1985
1990	86					1990
1995	94	885,000	42,500	23	2,765,400	1995
1998	89					1998
1999	94					1999
2000	95					2000
2001	93					2001
2002	93					2002
2003	91					2003
2004	95					2004
2005	95					2005

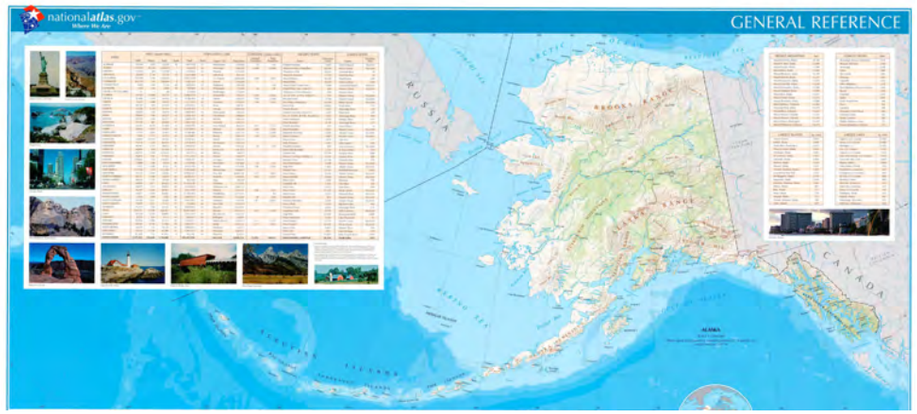
(Source: UNFAO, Fisheries and Aquaculture Department, "Global Capture Production, 1950-2005")

World Map that shows the U.S. share of global EEZs



(Source: by Lasunncty on Wikipedia)

Map of Alaska



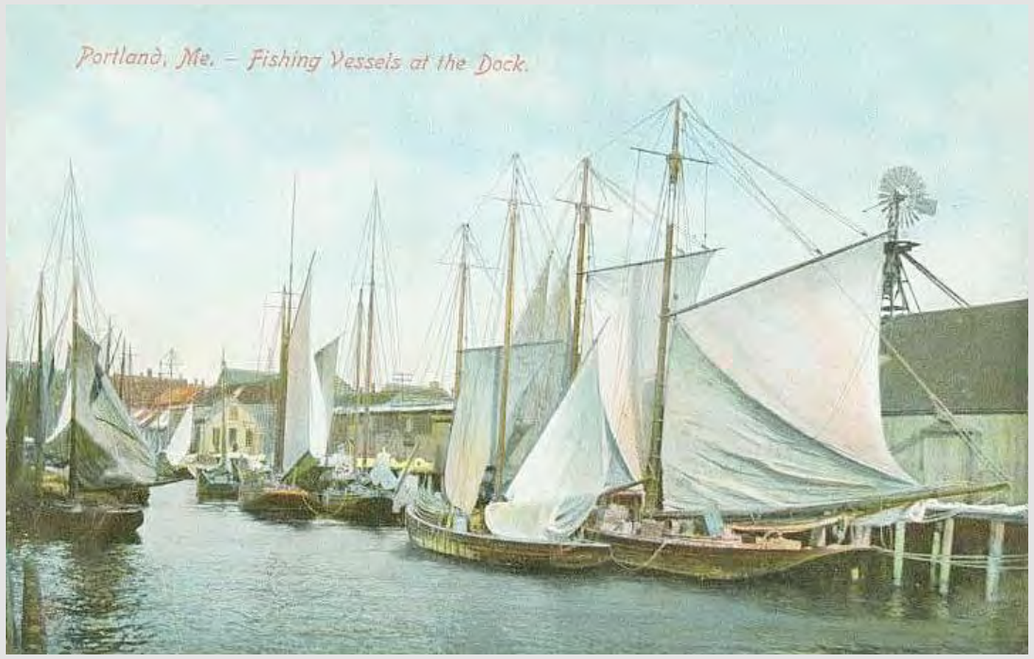
(Source: Public Domain)

Additional Images

Alaskan Fishing Vessel Hatcher

(Source: from Author)

Postcard of a Fishing Vessel docked in Portland, ME, 1908



(Source: Open Source-copyright expired)

Outdoing Panama: Turkey's 'Crazy' Plan to Build an Istanbul Canal

EDITOR'S NOTE:

Turkey's Prime Minister, Recep Tayyip Erdogan, recently unveiled a plan so ambitious that even he calls it the 'Crazy Project.' The project aims to build a massive canal that will bypass the Bosporus waterway that bisects Istanbul—a rival to the Panama and Suez Canals in time for the Turkish Republic's centennial celebrations in 2023. The new canal, Erdogan hopes, will overcome centuries of international intrigue over the Bosporus, facilitate trade, and reduce the possibility of shipping accidents through the heart of Istanbul. This month Origins Managing Editor James Helicke examines the international history surrounding the strategic waterway that has confounded sultans and statesmen. He asks if the 'Crazy Project' will solve the Bosporus dilemma once and for all, or if it is just plain folly.

Published August 2011.

By JAMES HELICKE

Turkey's Prime Minister, Recep Tayyip Erdogan, had a secret.

Months into his governing party's third successful election campaign in 2011, the populist premier gave the Turkish public a few hints about a major project that his government had imagined for Istanbul, the largest city in Turkey—and Europe.

It would be ambitious. Massive. It would be a "crazy project," as Erdogan and the public coined it.

A ship moves along the Bosporus through Istanbul, part of the only sea route from the Black Sea to the Mediterranean. Turkish Prime Minister Recep Tayyip Erdogan's 'Crazy Project'—a plan to build a canal to bypass the treacherous waterway—was a centerpiece of his successful 2011 reelection campaign. But it remains to be seen if the Canal will overcome dangerous bottlenecks on the busy Bosporus and a long history of international intrigues over the Straits. (Source: Wikipedia)

Turks imagined: Could it be a cultural center and mosque replicating the Selimiye, the sixteenth-century masterpiece of the great Ottoman architect Mimar Sinan?

Maybe a mammoth "park of civilizations" suspended high over the Bosporus, the rough waterway that bisects the city and marks the geographic boundary between Europe and Asia?

Turkey's Prime Minister Recep Tayyip Erdogan. (Source: Flickr/ Kuwait-Ra'ed Quten)

Perhaps, in a nod to crowding in this city of 15 million people, Dubai-like man-made islands shaped like the star and crescent on the Turkish flag?

Or, a solution once and for all to Istanbul's troubles on the Bosporus—a strait crowded not only with urban commuters and pleasure craft, but Russian oil tankers protected by international agreements as they carry crude on the only sea route from the Black Sea to world markets?

Erdogan did not disappoint.

In an April 27, 2011 multimedia blitz, he unveiled the eagerly-awaited project to a conference hall crowded with journalists, mustached businessmen, and pious housewives with colorful, silk headscarves.

"We give to Istanbul, Canal Istanbul!" Erdogan told the jubilant crowd. "Today we roll up our sleeves on one of the biggest projects of the century, with which the Panama Canal, the Suez and the Corinth Canal in Greece cannot even compete!"

The project outlined by Erdogan calls for a 45-50 kilometer (28-31 mile) canal, some 25 meters (27 yards) in depth and up to 150 meters (164 yards) in width, to be dug west of Istanbul.

The canal would bypass the Bosporus, the site of multiple shipping accidents, and link the Black Sea to the Marmara Sea.

A large ship on the Bosporus. (Source; Wikimedia Commons)

A campaign ad for Turkey's governing party reads: 'Turkey is ready. The target is 2023. May the stability continue. Let Istanbul grow.' (Source: Flickr/ Alain Bachellier)

The canal would be a "second Bosporus" as many news outlets called it.

After passing through the canal from the Black Sea, ships would then continue on their normal route through the Marmara Sea and Turkey's less treacherous Dardanelles on their way to the Aegean, the Mediterranean and ultimately to world markets.

Material from Turkish Prime Minister Recep Tayyip Erdogan's successful 2011 reelection campaign that says: "A magnificent project, Canal Istanbul" and "Turkey is ready. The target is 2023." (Source: Adalet ve Kalkinma Partisi (Justice and Development Party)

"With Canal Istanbul, we will bring an end to freight traffic on the Bosporus. And we will give back the Bosporus to Istanbul and Turkey," Erdogan said.

Erdogan's Bosporus dream is the culmination of centuries of imagination and intrigues over Istanbul and the Straits.

Throughout the nineteenth and twentieth centuries, European powers vied over who should—and should not—be given access to the waterways as statesmen sought to maintain the balance of power in Europe and the region.

Although sovereignty now belongs to Turkey, international conventions have long restricted Turkey's ability to limit steadily increasing ship traffic. Much of the Bosporus traffic now includes hazardous materials and oil, leaving thousands—or even millions—vulnerable.

But there is more to Erdogan's plans for the straits than environmental woes or Bismarckian *realpolitik*.

The project speaks to a long tradition of political imagination, ambitious state-planning and—perhaps most of all—Erdogan's own political designs for the country.

The canal and related "crazy projects" for other cities in Turkey—major transportation and housing projects—were the centerpiece of Erdogan's Justice and Development Party's third straight electoral victory since 2002.

In elections on June 12, 2011, Erdogan's party won nearly 50 percent of the vote, picking up 325 of 550 seats in parliament.

Secular critics have accused Erdogan, a practicing Muslim and former member of a banned pro-Islamic party, of plotting to move Turkey away from its official secular ideology toward a more Islamic path. He also has been accused of slowly, but surely inching toward greater absolutist rule.

Erdogan, who calls himself a conservative along the lines of European-style Christian democrats, has consistently denied any Islamic agenda and says his goal is to strengthen the country's democracy.

Under Erdogan's leadership, this overwhelmingly Muslim country of 75 million has also moved closer to its goal of membership in the European Union than under any of his more secular predecessors. Yet, by all accounts, achieving that goal remains only remotely possible or, at best, years away.

Nonetheless, the party's electoral slogan was boundlessly optimistic. "Target 2023," simultaneously looked to history—Turkey's founding as a nation-state in 1923—and its future centennial celebrations in the next decade.

Said Erdogan: "Turkey more than deserves to embark on such a great, crazy, and magnificent project for 2023!"

Istanbul and Dreams of Turkish Greatness

Erdogan laced his hour-long speech announcing the project with stories of triumph and disaster, poetry, and references to Ottoman and Turkish historical grandeur.

According to Erdogan, Turks share a dream of Turkish national success that he traced back to Osman, the eponym for the Ottoman Empire whose life and reign spanned the thirteenth and fourteenth centuries.

According to legend, Osman dreamt of a colossal tree sprouting from within himself and spreading across the region—a story Turks have interpreted as an allegory for the founding and growth of the Ottoman Empire.

"At the foundation of a great civilization, there is, foremost, a dream. We too have established a dream for our country," Erdogan said.

In many ways, Erdogan is but the latest ruler over the centuries to transform the city on the Bosporus.

At a time that the Roman Empire was under siege, Constantine moved his capital from Rome and transformed the town of Byzantium into Constantinople in the fourth century. The city became the largest in Christendom, boasting the sixth-century Hagia Sophia, once the largest church in the world.

Venetian artist Gentile Bellini's 1480 depiction of Fatih Sultan Mehmet II, who conquered Constantinople (Istanbul) in 1453. (Source: Wikimedia Commons)

By the fifteenth century, when the Byzantine Empire was just a shadow of its former self, the imperial capital—guarded by walls, a massive chain across the Bosporus, and fortuitous geography—was the last Byzantine city to succumb to Ottoman forces.

According to Erdogan's account, Fatih Sultan Mehmet II ("Mehmet the Conqueror") shared a dream similar to his own when Ottoman forces built fortifications to gain control of the Bosporus and even carried some warships overland to conquer Constantinople in 1453.

For Mehmet II and Ottoman forces, "the city"—as it was often called with affection—had stood like a dagger at the heart of the Ottoman Empire that now surrounded it on all sides, inhibiting Ottoman expansion to Europe and the Middle East.

At the apex of Ottoman rule, Suleyman the Magnificent (1520-1566) again transformed the city on the Bosporus by ordering the construction of new mosques, schools, and other monuments—making it the worthy capital of a ruler who claimed legitimacy as both a Muslim ruler and as "Caesar of Rome."

Canals and the Transformation of Nature

The massive nature of Erdogan's project, which includes not only the Canal itself, but the launch of two new major settlements along the Canal Zone connected by a new, third bridge over the Bosporus, speaks to a longer tradition in Turkey of ambitious nation-building and infrastructure projects in the twentieth century.

Of course, Turkey is hardly alone in such promethean ventures, and Canal Istanbul will join a long list of grandiose construction projects that cram the volumes of human history.

A medieval shipwreck uncovered during archaeological excavations for the Marmaray tunnel project beneath the Bosporus. (Source: Flickr/ Andrew Barclay)

Canals throughout history have long been connected to broader patterns of political, economic and military expansion and integration.

The peoples of ancient Mesopotamia and the Indus Valley used canals for irrigation, encouraging the growth of life in towns and civilization more broadly.

Canals featured prominently in the development of ancient China by helping to bring unity to formerly disparate states. The Grand Canal of China, completed in the seventh century CE, remains by far the longest canal in the world at nearly 1,800 kilometers (nearly 1,120 miles)—far surpassing the canals of Suez (193 kilometers or 120 miles), Panama (77 kilometers or 48 miles) and Erdogan (45-50 kilometers or 28-31 miles).

The Greeks pioneered canal locks and probably completed the first canal to connect the Red Sea to the Mediterranean. Roman canals, moreover, not only served irrigation and transportation, but more broadly helped to integrate a far-flung empire.

In the eighteenth and nineteenth centuries, major canals in England and the United States accelerated British industrial development and American westward expansion.

The Suez Canal (opened in 1869), sometimes nicknamed the "highway to India," reduced travel to Britain's prized colony by connecting the Mediterranean to the Red Sea. It also helped to unleash a new wave of imperialism in the second half of the nineteenth century.

One of the greatest engineering feats of all time, the Panama Canal opened in 1914 only by propping up Panamanian secessionists, overcoming disease, and opting for an elevated canal with locks and dams rather than one at sea level. (Frustrated, Ferdinand de Lesseps, who led the construction of the Suez Canal, abandoned Panama in disgrace). In the end, the Panama Canal not only connected the Atlantic and Pacific Oceans, but contributed to a new American form of empire.

What is perhaps unique about Erdogan's canal—which will bypass the Bosporus and provide duplicate access from the Black Sea to the Marmara—is that it is likely among the few to replicate that which already has been given by nature.

The Eastern Question

It remains to be seen, however, if this replacement of a natural waterway with a human engineered one will bring a definitive end to one of Turkey's most difficult military and diplomatic challenges: the so-called "Eastern Question." This nineteenth-century Eurocentric "Question"—what to do with a weakening Ottoman Empire seen as past its heyday—may now be over, but the issues it raised about Turkey's place in the international community linger today.

The Straits of the Bosporus and the Dardanelles have long defined the geopolitical relationship of Turkey (and the Ottoman Empire before it) and the rest of the world.

But it was arguably the turn of the nineteenth century that marked the transition of the Bosporus and Straits from a blessing to a curse for the Ottoman Empire.

Although Ottoman historians now vehemently reject the term "decline," there can be little debate that the Ottoman Empire witnessed a series of struggles after the eighteenth century.

Russia's growth, its aspirations for access to the sea, and increasing assertion of imperial might often came at Ottoman expense.

Many scholars see Ottoman defeat in the Russian-Ottoman War of 1768-74 as a major turning point in Turkey's relations with European powers.

The humiliating Treaty of Kucuk Kaynarca (1774) gave the Crimean Peninsula to Russia, along with passage rights through the Dardanelles, and disputed political rights over Ottoman Orthodox Christians.

Russia's new status as a Black Sea power not only raised questions about Russian access to the Mediterranean through the Straits, its challenge to the Ottoman Empire raised questions about how to maintain the balance of power in Europe—that tacit understanding among European statesmen that no state should become too strong to dominate the others.

At the heart of this "Eastern Question" was the future of the Ottoman Empire and the question of the Straits.

The Treaty of Hunkar Iskelesi (Unkiar Skelessi, 1833) stipulated that the Ottoman Empire be required to close the Straits to foreign powers at Russia's request. Fears that these provisions disrupted the balance of power by giving Russia too much privilege led to the Straits Convention of 1841, which closed the

Straits to all but the Ottomans in peacetime. This kept Britain and France out of the Black Sea and Russia out of the Mediterranean.

Subsequent agreements sought to maintain the balance of power by stipulating who had right to the Straits and when.

The Treaty of Paris (1856) and the Treaty of London (1871) returned to the "ancient rule" of the Ottoman Empire that warships should not use the Straits except by the special permission of the Sultan during times of peace.

Yet, maintaining balance in the international arena became increasingly challenging as indigenous nationalism and European powers continued to chip away at Ottoman territory. Amid these struggles, Europeans sometimes called the Ottoman Empire the "Sick Man of Europe"—to the consternation of Ottoman statesmen and contemporary historians.

Some Turks continue to see similarities in Turkey's limited ability to control international shipping traffic through the Bosporus and nineteenth-century European designs on Ottoman territory.

And with its bid for EU membership at a standstill, at least one component of the old Eastern Question—what should Europe do with Turkey?—remains unresolved.

The Struggle for Control of the Straits

The question of the Straits also lay at the very heart of many of the twentieth century's most difficult military and diplomatic questions.

An Ottoman stamp commemorating the Ottoman victory at Gallipoli during the First World War. (Source; Wikimedia Commons)

Although the Ottoman Empire initially professed neutrality in the First World War, its decision to grant harbor to two German warships, the Goeben and Breslau, ultimately tipped the Ottomans toward an alliance with Germany.

The German vessels had avoided British naval pursuit and, in August 1914, passed into the Turkish Straits, challenging British and French domination of the Mediterranean and Russian domination of the Black Sea.

The American ambassador to the Ottoman Empire, Henry Morgenthau, wrote: "I am convinced that, when the judicious historian reviews this war and its consequences, he will say that the passage of the Strait by these German ships made it

New Zealand soldiers at Anzac Cove, Gallipoli, 1915. (Source; Wikimedia Commons)

inevitable that Turkey should join Germany … and that it likewise sealed the doom of the Turkish Empire."

Winston Churchill proclaimed that, by drawing the Ottomans into the fighting and extending the war, the passage of the two vessels brought "more slaughter, more misery and more ruin than has ever before been borne within the compass of a ship."

Gaining control of the Straits was the goal of the Gallipoli Campaign, which from April 1915 to January 1916 unsuccessfully sought to take the waterways and Ottoman capital.

With involvement by such colorful figures as Churchill, Mustafa Kemal Ataturk, and the Anzacs (the Australian and New Zealand Army Corps), Gallipoli helped to forge a sense of nationhood not only for the besieged Turks, but also New Zealanders and Australians. Turks won the battle, but lost the war.

The Treaty of Sèvres (1920)—one of six treaties prepared at the

The German warship Goeben in the Bosporus before 1917. (Source:German Federal Archive Bild 134-B0024)

Paris Peace Conference that brought an end to World War I—established an occupation over much of today's Turkey. It established a Zone of the Straits, comprised of Istanbul and other territory along the Straits, and placed it under the control of an international commission.

It also declared that the Straits "shall in future be open, both in peace and war, to every vessel of commerce or of war and to military and commercial aircraft, without distinction of flag."

For the Turks, the foreign occupation in the heart of their territory—with division of much of the Anatolian heartland among neighbors, European powers, and minority groups—became a symbol for Turkey's national resistance. Even today, Turks associate the term "Sèvres" with betrayal and selling out to foreign powers.

From 1919 to 1923, Mustafa Kemal Ataturk rallied Turkish nationalists to gain sovereignty over Turkish territory and the Straits.

Although the new Treaty of Lausanne (1923) gave Turkish nationalists most of the territory they sought, the treaty retained an international commission for the Straits, which remained demilitarized.

Over the next decade and a half, Ataturk—the name that he adopted in 1934—introduced sweeping reforms aimed at strengthening the new nation-state and consolidating his control.

Westernization reforms limited Islam's influence over politics, switched from the Arabic to Latin script for the Turkish language, and even mandated that men must no longer wear the fez, but European-style hats.

Ataturk moved the capital from Istanbul to Ankara, transforming the latter from a sleepy, provincial town to the capital of the new nation-state—with broad boulevards, government buildings, schools, and his own pet project: an experimental farm.

Mustafa Kemal Atatürk teaching the new Turkish alphabet in 1928. (Source: Wikipedia)

As Turkey grew in strength and turmoil grew in Europe, Turkey pulled off one of its greatest foreign policy triumphs: revision to the regime governing the Straits.

The Montreux Convention, which remains in effect today, abolished the Straits Commission and once again returned authority over the Straits to Turkey. In addition to allowing remilitarization, Turkey could restrict the passage of ships during wartime. It was obligated, however, to allow the passage of merchant vessels during times of peace.

Ataturk's legacy of ambitious state planning has not only left a profound mark on the seven decades of Turkish politics since his death, but Turkey's approach to foreign policy and the Straits have been profoundly shaped by the treaties—Lausanne and Montreaux—that he helped broker.

The Bosporus in the Vice of the Cold War

After the Second World War, the Straits, especially the Bosporus, remained an issue of contention and a symbol of Turkey's place in the world. Turkey resisted any revision to the Straits regime that might limit its control over the waterways.

Eager to avoid the disastrous consequences of picking the wrong side like they did in the First World War, Turkish leaders pursued a precarious policy of neutrality aimed at averting direct involvement in World War II.

A chain similar to this one (which spanned the Golden Horn inlet of the Bosporus) used to span the Bosporus itself as a defense to block attacking ships. (Source; Wikimedia Commons)

Turkey's wavering policy instead drew the ire of an increasingly powerful Soviet Union and the Straits became integral to Cold War strategic equations.

In 1945-1946, the Soviet Union insisted on a revision to the Straits regime that would allow it to maintain forces there and also pressed for claims to other Turkish territory. An eminent Turkish journalist proclaimed that "the old Eastern Question has risen from its grave."

U.S. President Harry S. Truman delivering his 1947 "Truman Doctrine" speech for the protection of Turkey and Greece. (Source; Truman Library)

In 1946, the U.S. Ambassador to Turkey observed that "control of the Straits … obviously is of much more importance" than any other Soviet demands.

The defense of Turkey and Greece from communism provided the public justification for the 1947 Truman Doctrine. The speech by U.S. President Harry S. Truman was then the clearest public enunciation of the U.S. policy of the containment of communism, which dominated U.S. strategy throughout the Cold War.

By the 1950s, the United States considered the use of mines on the Straits to deter Soviet submarines from entering the Mediterranean. Turkey's alliance with the West solidified with its membership in the North Atlantic Treaty Organization (NATO) in 1952.

Bridges

As Turkey has deepened its alliance with the West, the Straits—and the Bosporus in particular—have become associated with new symbolism of Turkey as a bridge between cultures, civilizations, and continents.

Yet, the idea of a bridge over the Bosporus also has a literal meaning that reflected a long legacy of large-scale state planning in Turkey.

In 1957, Prime Minister Adnan Menderes announced plans to build the longest suspension bridge outside the United States—over the Bosporus.

The bridge was part of an ambitious urban revitalization project to raze "slums" (including historic structures) and build "modern" new housing, parks, roads, and highways in Istanbul. The government claimed it was "carrying out the dream of Kemal (Ataturk) to make Istanbul … 'most beautiful and modern,'" according to a 1960 New York Times article.

Ferries carrying commuters on Istanbul's Bosporus. (Source: Yusuf Atalan)

The bridge project was interrupted by a 1960 military coup—the first of several military interventions.

In 1963, Turkey became an associate member of the European Common Market. In 1967, the bridge project was finally revived. Chancellor Willy Brandt—the architect of West Germany's own outreach to the Soviet Union,Ostpolitik—declared: "This bridge signifies Turkey's wish to join Europe."

In October 1973, two years after Turkey's second coup d'état, the Bosporus Bridge—with a total span of around 5,000 feet (1,500

Construction on the tunnel project under the Bosporus, Marmaray. (Source: Flickr/ Henri Bergius)

meters)—was finally complete. Its status as the first bridge across two continents filled world newspapers along with clichés of Turkey as a bridge between civilizations.

Bosporus Bottleneck

The Bosporus Bridge did not solve Turkey's Bosporus dilemma, nor did improved relations with its eastern neighbors.

As thousands and thousands of migrants from across Turkey continued to flock to Istanbul each year, it was clear that a single bridge would not adequately address Istanbul's growing population and deadlocked traffic.

In 1987, Prime Minister Turgut Ozal, who led Turkey after a nasty 1980 military coup and promoted political and economic liberalization, opened a second bridge over the Bosporus: the Fatih Sultan Mehmet Bridge, named after the Ottoman sultan who conquered Istanbul.

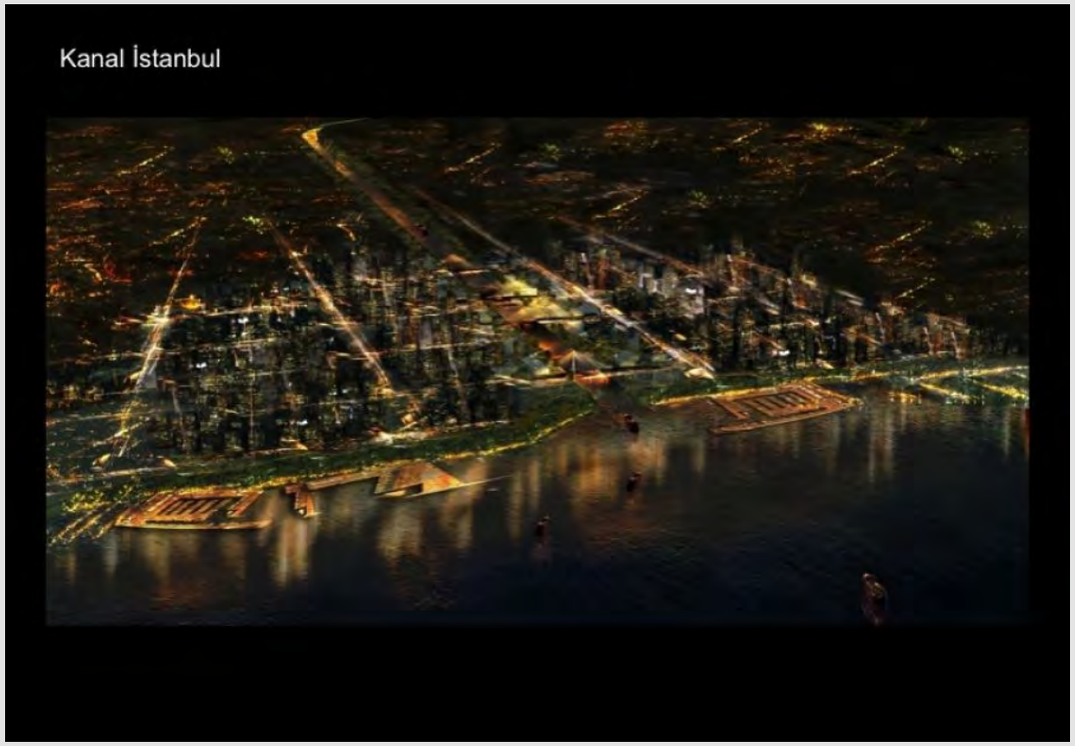
Since the 1990s, governments from across the political divide have been pushing for a third one, which has been held up by legal challenges from property owners.

Erdogan has also backed a $2.5-$3.0 billion rail tunnel project under the Bosporus, known as Marmaray, which has been under construction since 2004. He has sometimes chided archaeological excavations along the route for holding the project up.

Yet, solutions from beneath and above will not solve Turkey's biggest Bosporus problem.

The waterway is harrowing, with sharp curves, blind spots, and shifting currents. Ferryboats and private boats zigzag across the strait, which they share with giant oil tankers and the occasional cruise ship.

Traffic within the treacherous waterway has steadily increased over the years. Turkish authorities say that in 1936 around 4,400



A rendition of Canal Istanbul presented by Turkey's governing Justice and Development Party. (Source: Justice and Development Party)

vessels passed through the waterway. Today, that number is around 50,000 annually—a more than ten-fold increase.

Unsurprisingly, around 460 accidents occurred between 1953 and 2002, most collisions. These have included multiple spills.

In 1960, Yugoslav and Greek tankers collided, killing 20 and leaving a fire that burned for weeks. In 1966, two Soviet tankers collided.

Ferryboats have struck other vessels. Significant spills of crude, gasoline, and other chemicals occurred in 1964, 1966, 1979, 1990, 1994, 1999, 2002 and 2003.

In his speech, Erdogan referred to the 1979 collision of the Romanian-flagged *Independenta* with a Greek ship that killed more than 40 people and left a pile of wreckage that burned for weeks.

While Erdogan was mayor of Istanbul, a 1994 collision killed 29 and brought passage in the Straits to a halt.

As oil from countries of the former Soviet Union has increasingly made its way to world markets since the collapse of the U.S.S.R., pressure on the Bosporus has only increased.

In response, Turkish governments have encouraged pipeline projects, such as the Baku-Tbilisi-Ceyhan pipeline from Azerbaijan to a Mediterranean port in southern Turkey. Another oil pipeline, scheduled for operation in 2012, will bring crude from the Black Sea to the same port.

According to Erdogan, more than 358 million tons of freight is carried on the Bosporus every year, including 4 million tons of liquefied petroleum gas, 3 million tons of chemicals, and 139 million tons of petrol.

These "dangerous materials threaten our Istanbul, the beauty of our Istanbul, and the people of our Istanbul every day and every hour," Erdogan proclaimed as he announced Canal Istanbul.

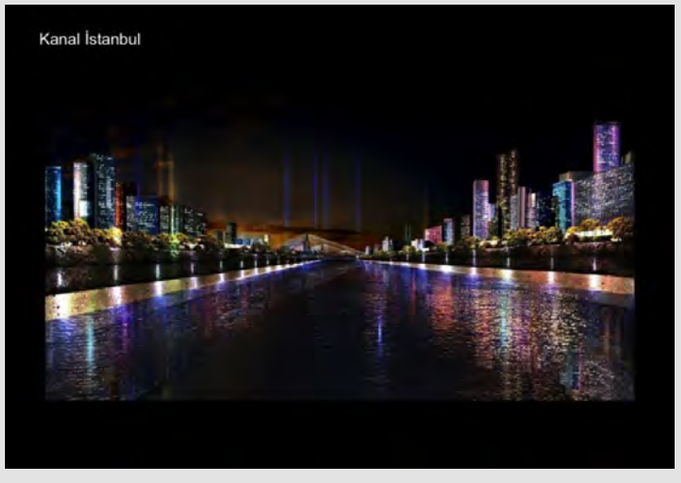
"From now on, the Istanbul Bosporus will return to its former days —a wonder of the world where the past and future live side by side …"

Ataturk's Dream, Erdogan's Dream

There are many reasons to doubt that Canal Istanbul will solve all of Turkey's Bosporus problems.

For one, Turkey has limited say over the passage of merchant ships as guaranteed by the Montreaux Convention, which on other occasions Turkey has so vigorously upheld.

"If passage is free through the Bosporus, then why would anyone use this canal?" Russia's ambassador to Turkey asked frankly in an interview with the Hurriyet newspaper.

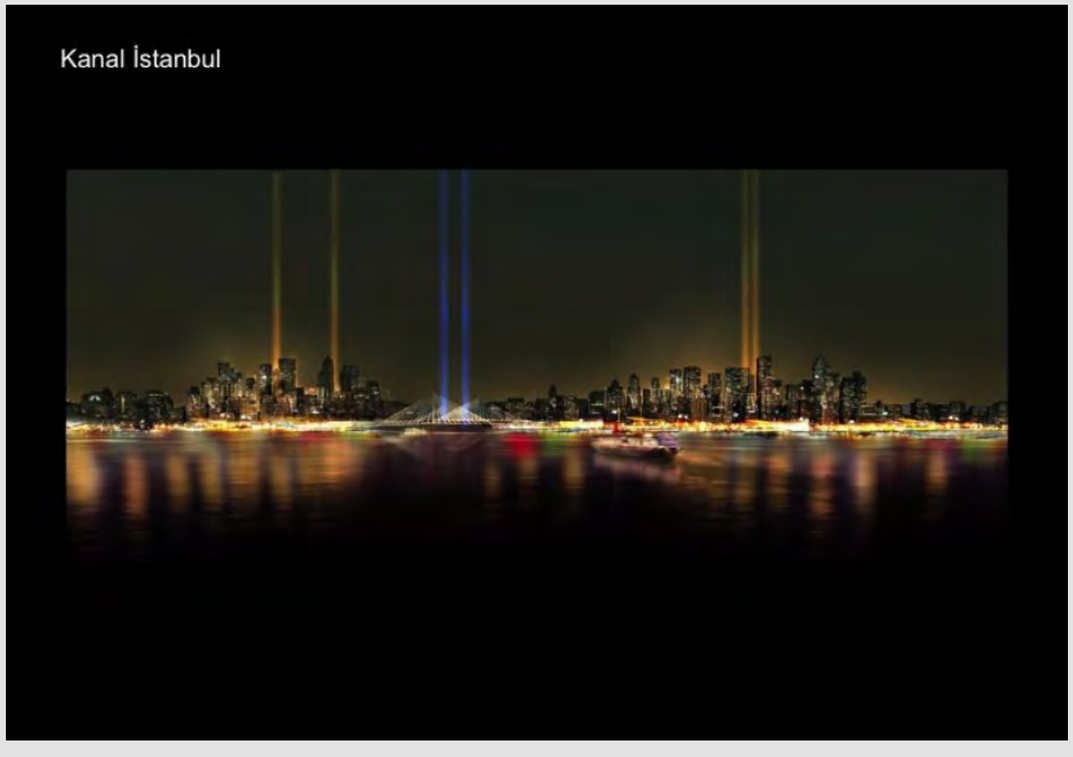


A rendition of Canal Istanbul as presented by Turkey's governing Justice and Development Party. (Source: Justice and Development Party)

Moreover, critics complain that the canal—which Erdogan says will accommodate 130-160 ships daily compared to around 150 on the Bosporus—could simply double the number of ships that can pass through the Bosporus chokepoint by offering an additional route.

Yet for all these obstacles, Erdogan—like Turkish politicians across the political divide—continues to press for ambitious, large-scale projects.

At a time that many Europeans are faced with stark austerity measures and American political rhetoric stresses spending cuts and limited government, Canal Istanbul is but one such project funded by state coffers.



A rendition of Canal Istanbul as presented by Turkey's governing Justice and Development Party. (Source: Justice and Development Party)

Erdogan paid customary political lip service to Ataturk in announcing the project. But Erdogan's Bosporus project is deeply personal—and political.

The former mayor of Istanbul was once banned from politics even as his Justice and Development Party swept into single party rule in 2002.

Only through legal changes approved by a parliament dominated by his party and a special backwater election could Erdogan finally secure a seat in parliament and become premier.

Tactics such as those, his promulgation of conspiracy theories involving Turkey's military and political rivals, and heightened crackdowns on journalists—perhaps making Turkey the lead jailer of journalists in the world—have raised concerns about Erdogan's intent as a political leader.

Many critics have also expressed alarm at some of Erdogan's reforms, including proposals to replace Turkey's constitution, drafted under military direction following a 1980 coup, with a new constitution giving greater authority to the president—a position in which Erdogan has expressed interest.

Although critics and supporters differ on the nature of Erdogan's vision, it is clear that he envisions Turkey as a major world political and economic power.

Under Erdogan, Turkey enacted ambitious reforms and opened formal membership negotiations with the European Union in 2005, although those talks have since stalled.

Yet, there is little question that the country has prospered economically under Erdogan. With 6.8 percent growth in 2010, Turkey boasts the fastest growing major economy after China and India.

In his speech, Erdogan rattled off figure after figure aimed at impressing the Turkish electorate: Per capita income had nearly quadrupled over the past decade—from $2,300 to over $10,000—and Turkey strives to become one of the world's ten largest economies by 2023.

Canal Istanbul is but one part of that broader economic agenda.

Erdogan emphasized that the project for Istanbul—the economic heart of Turkey that holds 40 percent of the country's wealth—would benefit all of Turkey.

"Canal Istanbul will also provide for a new place to live with centers for conferences, festivals and fairs, hotels, and sports facilities. Istanbul's urban transformation will continue along with the projects we will carry out around the Canal. We will build Istanbul's biggest airport here," he said. "The Third (Bosporus) Bridge will also go over this canal."

Ironically, the construction of the Canal will transform the European section of Istanbul into an island surrounded by the Bosporus on one side and the canal on the other—perhaps further isolating it from the rest of Turkey.

Erdogan, meanwhile, has been hush about where exactly the Canal will be, its cost, and construction, saying such disclosure might lead to unjustified criticism. ◆

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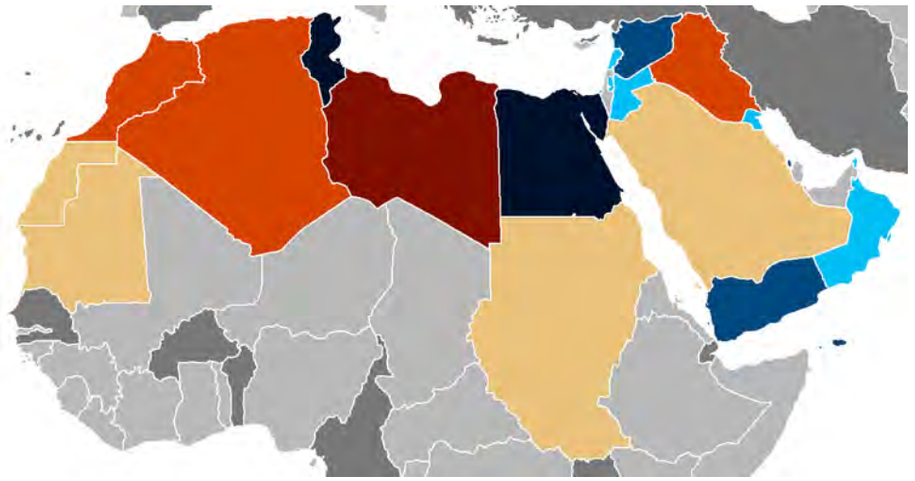
Maps and Charts

A map showing countries affected by the Arab Spring (Comments: Revolutions (Tunisia, Egypt) are shown in black, civil war (Libya) in brown, sustained civil disorder and governmental changes (Syria, Yemen) in dark blue, protests and governmental changes (Jordan, Oman, Lebanon) in light blue, major protests (Morocco, Algeria, Iraq) in orange, and smaller protests (Western Sahara, Mauritania, Sudan, Saudi Arabia) in tan.



(Source: Justice and Development Party)

Map of Turkey

(Source: CIA)

Map showing the Baku-Tbilisi-Ceyhan pipeline

(Source: Wikimedia Commons)

Additional Images

A satellite image of the Bosporus

(Source: NASA)

An 1853 cartoon shows European statesmen discussing the future of the Ottoman Empire, which is portrayed as the 'Sick Man of Europe.'

(Source: Punch Magazine)

Top Ten Origins: Dams

By PAUL NIEBRZYDOWSKI

For millennia, dams have played a central role in human life and natural systems. They have served myriad uses for humans, from collecting water for irrigation, drinking, bathing, and leisure, to mitigating flooding, milling grain, stocking fish, and producing energy. The twentieth century in particular saw an unprecedented flurry of dam construction, especially for hydroelectric power. Dams like the Hoover Dam in Nevada and the Three Gorges Dam in China stand as icons of the modern, industrialized world. When the Bonneville Dam opened on the Columbia River in 1937, writer Lewis Mumford hoped hydroelectric power would allow for cheap and sustainable urban development in Oregon but Mumford's utopian dream never saw fruition. As huge new dams are being built in Brazil and China, while campaigns to decommission dams are gaining traction in the United States (especially in the western U.S.), Origins takes a look at human dams across history to reflect on the many ways that humans have chosen to engineer their rivers and waters.

Published 2016.

1. Roman Dams Still in Use

The Cornalvo Dam, near the city of Mérida in Spain. (Source: Wikimedia Commons)

The Romans were amazing water engineers. They employed a number of hydrological technologies to divert water for purposes of irrigation, settlement, drinking, bathing, and even recreation. In contrast to other Roman ruins, which now serve as tourist

attractions, many Roman dams remain in use to this day, mostly as drinking reservoirs. The Romans erected dams primarily in areas with poor precipitation, such as the Mediterranean basin and Syria, in order to ensure sufficient water for irrigation of crops and drinking water. One of the oldest still in use for drinking water, the Cornalvo dam, can be found a few kilometers from Mérida, in western central Spain. Built between 1 and 2 CE, the dam stands as a remnant of the former Roman provincial capital, which earned it distinction as a UNESCO World Heritage Site in 1993. At 28 meters it stands just higher than its nearby cousin, the Prosperina dam. The Lake Homs Dam in Syria, built around the same time, continues to supply drinking water to the besieged city of Homs.

2. Nero's Dams at Subiaco

Constructed during the reign of the infamous Roman emperor Nero (54-68 CE), the dams at Subiaco (in the province of Rome) sustained pleasure lakes at the ruler's summer villa. The Subiaco dams were the only examples of large-scale dam technology used by the Romans in Italy. These gravity dams used the weight of their material to halt the flow of water. Other forms of dams, such as arch or buttress dams, use their geometry to resist and divert water pressure. The largest of the Subiaco dams stood as the highest dam in the world until its alleged destruction by clumsy monks in 1305. Located near the Roman capital, the Subiaco dams also served some municipal functions. Scholarship on Roman drinking water suggests that the water quality of Rome's many aqueducts varied significantly. Most of the water deemed unsuitable for drinking went to irrigation, but in some cases Roman engineers diverted aqueducts from the Aniene River into Nero's pleasure lakes, which acted as a settling basin.

The Aniene River near Subiaco, Italy. (Source: Wikimedia Commons)

3. Hoover Dam: Hydroelectricity and Water in the U.S. West

Photograph of the Hoover Dam by Ansel Adams from 1942. (Source: Wikimedia Commons)

The U.S. Bureau of Reclamation (BOR) was founded in 1902, but left its greatest legacy between the 1930s and the 1960s. During that time the Bureau oversaw the construction of more than half of its 340 active dams. In 1928, Congress approved a bid by a consortium of utility companies to construct the Hoover dam on the Colorado River. Upon completion in 1935 the Hoover dam

A sketch of the proposed reservoir. (Source: Wikimedia Commons)

was the largest in the world and one of the largest concrete structures at the time. Its reservoir, Lake Mead, retains the title of largest man-made lake in the United States.

The construction of the Hoover Dam required that the seven states in its basin—Colorado, New Mexico, Utah, Wyoming, Nevada, Arizona, and California—agree to water management standards set by the Colorado River Compact of 1922. Unfortunately, the data used to establish those standards did not reflect actual long-term averages of precipitation. A 2007 study concluded that the negotiation of the compact occurred at a time when the flow of the river was unusually high, 20.2 cubic kilometers per year, compared to a more realistic average of 16.5. As the only water source in a very dry region (what used to be called the “Great American Desert”), the peoples and

governments on the Colorado River now struggle mightily to manage with ever-growing water shortfalls.

4. Dam Removal: the Elwha River and Glines Canyon

A photo of the Elwha Dam taken for the Lower Elwha Fisheries office in 2005. (Source: Wikimedia Commons)

Many of the dams built by the BOR in the Pacific Northwest have come under harsh criticism for their devastating effect on salmon populations. Between 2012 and 2014 the U.S. National Park Service decommissioned two dams on the Elwha River: the Elwha dam, completed in 1913, and Glines Canyon dam, completed in 1927. The dams produced little electricity and blocked over 70 miles of vital salmon spawning habitat. Costly stunts like the transport of fish by boats up the river and past the dam drove activists to protest against the continued operation of these "deadbeat" dams. (One activist, Mikal Jakubal, famously painted graffiti cracks down the faces of both dams (see photo below)).

"Elwha be Free," with painted on cracks on dam. (Source: photo by Mikal Jakubal)

The five species of salmon have not been the only motivation for dam removal. In addition, populations of American Shad and Steelhead have had their ecosystems restored by letting rivers run free. The United States Comprehensive Environmental Response, Compensation, and Liability Act of 1980 has also provided the basis for the removal and cleanup of dams like the

Milltown Reservoir in Missoula, Montana, where the buildup of toxic sediment from nearby mines marked the location as a toxic Superfund site.

5. Dams not Built: Rampart Dam, Alaska

U.S. Geological Survey photograph of the Rampart Canyon. (Source: Wikimedia Commons)

The Rampart Dam in Alaska is perhaps the most famous hydroelectric dam that never existed. Planned and contested between 1944 and 1971, the project, proposed by the U.S. Army Corps of Engineers, aimed to dam the Yukon in central Alaska for hydroelectric power. The reservoir was to be roughly the size of Lake Erie, and would have overtaken Lake Mead as the largest man-made lake in the United States. (Though it would have still been smaller than the lake created by the Kariba dam on the Zambezi river, which was constructed in 1955 and remains the largest man-made lake on earth.)

Opponents argued that the displacement of Native American communities, the project's cost, and the devastation of the Yukon Flats (one of North America's most important waterfowl breeding grounds), outweighed the benefits of cheap electricity in a sparsely populated area. The proposed area for the Rampart dam's reservoir now belongs to the Yukon Flats National Wildlife Sanctuary, established by President Jimmy Carter in 1980.

6. The Politics of Dams: Egypt's Aswan High Dam

Dams are much more than artifacts or markers of man's industrious might; they also reflect developments in international politics. The Aswan High Dam in Egypt became not only a way to tame the mighty Nile, but also a major issue in the Cold War. When Secretary of State John Foster Dulles announced that the U.S. would not fund the dam's construction in 1956, he signaled an uneasy relationship between the United States and Egypt, helping to set the stage for the proceeding Suez crisis and the Cold War.

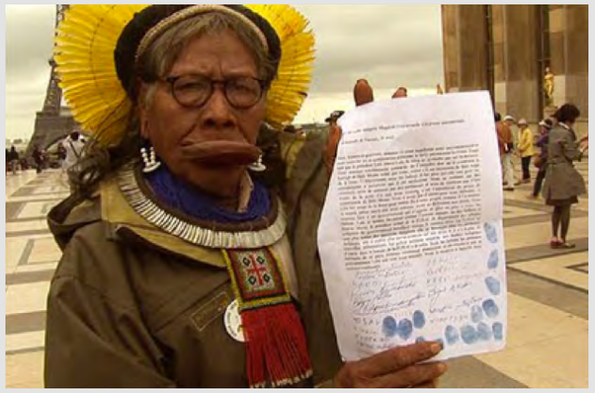
Egypt's President, Gamal Abdel Nasser, observing the construction of the Aswan Dam. (Source: Wikimedia Commons)

Dams built to tame the Nile in 1889, 1912, and 1933 had all overflowed. After almost two decades of political tension, British and Soviet Engineers completed the Aswan High Dam in 1970. It stands 364 feet tall and generates over 10 billion kilowatts, or about half of Egypt's power. In exchange for taming the damage of annual floods, farmers have become much more reliant on fertilizers, as silt, no longer dispersed by the Nile's floods, collects in Lake Nasser.

7. The Ongoing Appeal of Dams: Three Gorges Dam

Even as droughts and erratic weather patterns increasingly challenge the sustainability of reliable hydroelectric power, countries all over the world continue to construct massive dams to meet their energy needs. In 2008, with the opening of the Three Gorges Dam, China saw the completion of a century-long dream to dam the Yangtze River. As power changed hands over the course of China's turbulent twentieth century, massive projects to dam the Yangtze had captured the attention of the Nationalist government under Chiang Kai-Shek, the Japanese occupation

The Three Gorges Dam in China, photo 2009. (Source: Wikimedia Commons)



Pictured left: Chief Raoni, of the Kayapo people, showing his petition against Belo Monte Dam, which threatens indigenous territories on the Xingu river. (Source: Wikimedia Commons)

forces during WWII, and even the U.S. Bureau of Reclamation.

Approved by the People's Republic of China in 1992, the current dam is the most expensive hydroelectric facility ever built and one of the most expensive energy plants, at a cost of roughly $28 billion. In anticipation of even greater energy demands, China continues to plan massive hydroelectric projects. Upon its completion in 2020, the Baihetan dam will rank as one of the largest in the world (along with China's Three Gorges and Xilodu dams, and the Itaipu and Belo Monte dams in South America).

8. Under Construction: Belo Monte Dam in Brazil

Amid controversy, Brazil plans to complete its second largest dam by 2019. With a capacity over 11,000 megawatts, the Belo Monte Dam on the Xingu River (a tributary of the Amazon) in northern Brazil would be among the largest dams in the world.

But as Brazil's economic growth and reliance on hydroelectric energy increase, critics worry about the potential social and ecological repercussions. The dam's reservoir will flood and change rainforest habitat for hundreds of square miles, displace as many as 20,000 people, and threaten biodiversity of one of the Amazon's tributaries.

The Belo Monte Dam has also attracted criticism for its production of greenhouse gasses. In spite of Lewis Mumford's progressive hopes for hydroelectric power, many plants produce more carbon emissions than analogous facilities running on fossil fuels. Plant matter trapped by reservoirs decays anaerobically, which accounts for not only the net carbon produced but also high levels of methane, another significant greenhouse gas.

Pictured right: Greenpeace demonstration against the Belo Monte Dam. The bottom sign reads "Beautiful pile of shit." (Source: Wikimedia Commons)

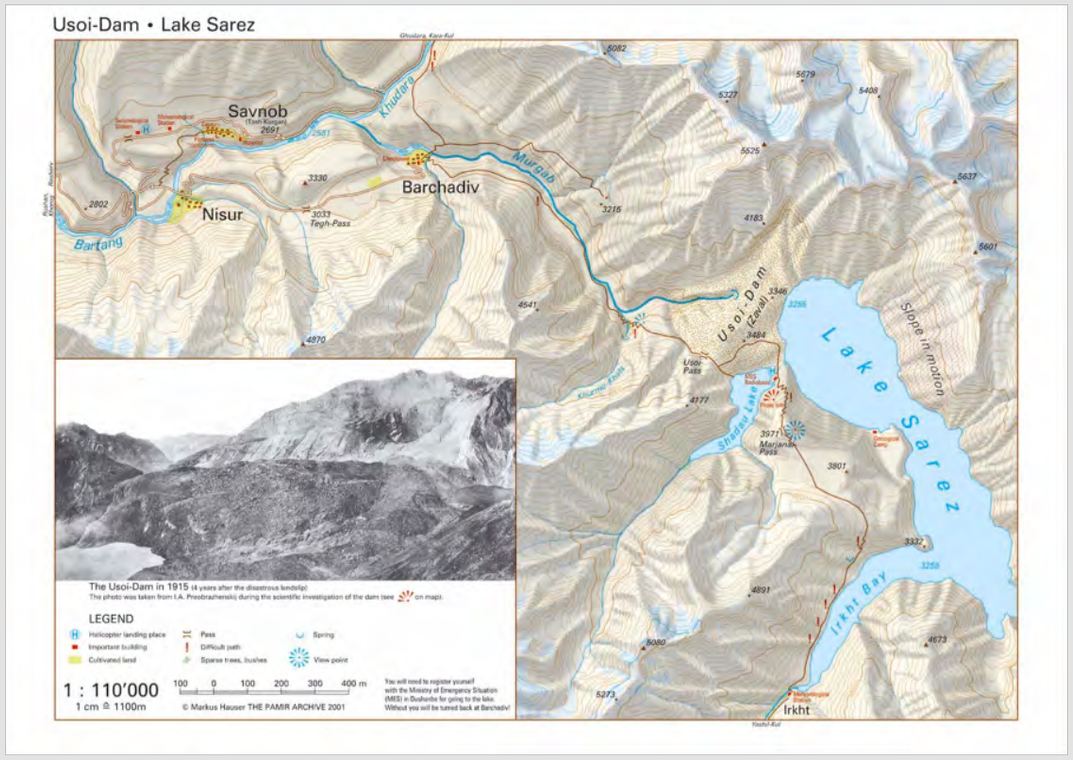
9. Other Types of Dams: Landslide Dams, Lake Waikaremoana, New Zealand

Humans can also benefit from the results of geological forces. The three power stations completed on New Zealand's Lake Waikaremoana between and 1929 and 1948 are unique in that

they are the only hydroelectric facilities built on an existing natural dam, which dates back to the creation of the lake by a landslide some 2,200 years ago. The projects to reinforce and utilize the massive natural dam, which at 400 meters dwarfs the Three Gorges Dam, stand as marvels of engineering boldness. The combined hydroelectric facilities produce about 125 megawatts of electricity, using weirs to redirect the lake's outflow into a useable hydraulic head of over 200 meters.

Lake Waikaremoana, photograph by Michal Klajban. (Source: Wikimedia Commons)

10. Nature's Tallest Dam: Usoi Dam, Tajikistan



Map of Lake Sarez and Usoi Dam. (Source: Pamir Adventure)

In 1911 a massive earthquake formed the Usoi Dam, a natural landslide dam on the Murghab River in Tajikistan. At 567 meters, it is the largest dam on earth. Its reservoir, Sarez Lake, while only a modest 30 meters squared, is unrivaled in its remoteness and beauty at over 10,000 feet above sea level. Unfortunately the dam and its lake have been a cause for concern. Although the World Bank maintained that the Usoi Dam was stable in a 2004 study, many warn that the threat of frequent seismic activity high in the Pamir Mountains will inevitably disrupt the dam, releasing over 16 cubic kilometers of water.

This photo shows Sarez Lake, the barrier pictured is not Usoi Dam, but rather an earthen division between the larger Sarez Lake, and a smaller body of water. (Source: Wikimedia Commons)

Bonus: Our Fellow Dam Builders, Beavers

Beavers remind us that humans are not the only animals who use technology to engineer their environment. Before European settlers arrived to North America, beavers and their dams played a crucial role in river ecology. But as European settlers began to construct their own dams for mills, beavers increasingly became a nuisance, blocking rivers and damaging farms and property with floods. As European settlers trapped valuable beaver fur for global market, they inadvertently transformed the hydrology of North America by removing these talented dam builders from the ecology and releasing water from untended former beaver dams.

With the rebound of beaver populations in the twentieth century, beavers have returned to their role as important ecological actors. Beaver dams help improve water quality and biodiversity through the creation of wetlands and also help curb soil erosion and drought by channeling run-off from streams into ponds. ◆

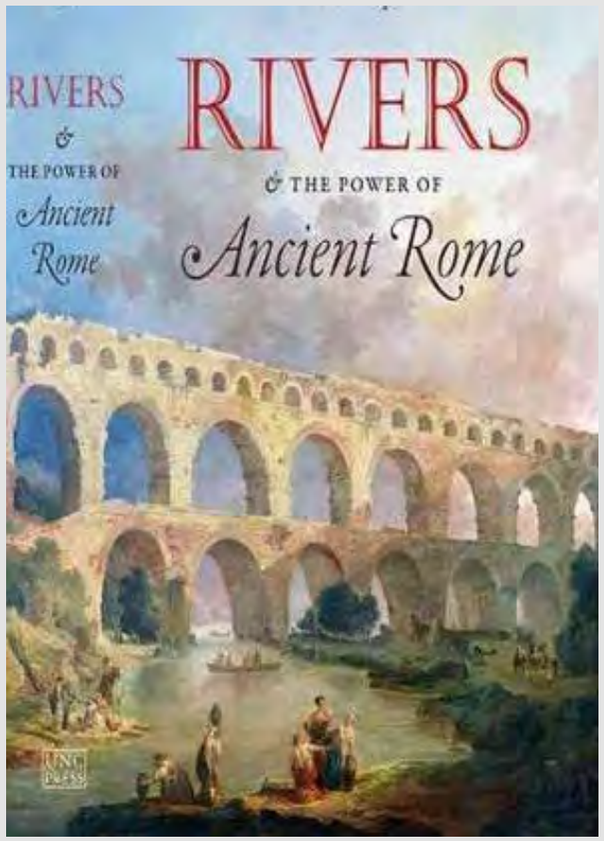
A beaver and its dam. (Source: Wikimedia Commons)

Rivers and the Power of Ancient Rome

Book review by
NICHOLAS BREYFOGLE

Published August 2014.

Rivers and the Power of Ancient Rome by Brian Campbell (Chapel Hill: The University of North Carolina Press, 2012).



by Brian Campbell (Chapel Hill: The University of North Carolina Press, 2012)

Benjamin Franklin famously quipped "when the well is dry, we learn the worth of water."

What was the worth of water in Ancient Rome? Floating along the extraordinarily diverse rivers of the Roman world, historian Brian Campbell tells us that the answer is a lot.

Roman representation of Tiber as a god (Tiberinus) with cornucopia at the Campidoglio, Rome. (Source: Wikipedia)

Rivers, he argues, flowed at the very core of Roman life: their religious world views and understandings of divinity, economic practices, legal systems, art and literature, drinking and farming, and their modes of transportation for people and goods. Rivers were crucial to mapping, boundary making, and control of

territory and were found at the heart of Roman ideas and practices of health, healing, sexuality, and leisure. Rivers were crucial to Roman territorial aggrandizement and their military systems. They served as symbols of strength and domination, of cooperation and conquest.

Stretching across three continents and framing the Mediterranean Sea, the long-lasting and expansive Roman polity and its people lived in a wide range of watery environments, from the dry regions of Spain and the Levant to the wetlands of Italy and Britain. The Roman world included some of the most remarkable rivers in the European, Middle Eastern, and African worlds: from the Nile, Tigris, and Euphrates, to the Rhine, Rhone, Danube, Po, Tiber, and Seine.

Statue personifying the River Nile and his children, from the Temple of Serapis and Isis in Rome, dated to the 1st century CE. (Source: Wikipedia)

Campbell sets himself a daunting task of writing the history of rivers across the length and breadth of Rome from the first century CE onwards. But he achieves admirably in bringing the riverine worlds to life.

Rivers and streams, he writes, all had their resident spirit; “great rivers had correspondingly important anthropomorphic deities, who led exciting and eventful lives in mythological stories, [and] this religious aura of rivers enhanced the status of riverine communities” (31). Rivers were ascribed human qualities and emotions, and often fathered children.

They also healed. Romans cherished the “cleansing force of running water” and this was “combined with [the] recognition of aquatic healing power especially in thermal springs.” The great Cicero pronounced “As long as a man is at the waters he is never dead” (367).

While the author tells us a great deal about shared riverine trends and connections across the whole Roman empire, he is always mindful of the ways in which the history of rivers also tells us “more personal, individual stories” (xiv). Rivers in the ancient world were lived and experienced in very local, site-specific ways. The annual flood on the Nile was an occasion for joy and celebration that would bring great harvests; yet floods on the Rhine were condemned and lamented for their destruction.

The study of Roman rivers comes with difficulties, however. There are only so many sources remaining today for the historian to gnaw on. And, in terms of terminology, just what was a “river” was perhaps less apparent than we might imagine. Romans had

many definitions of a river and used different words depending on a myriad of variables: amnis, flumen, fluvius, torrens, rivus, fons, and the list goes on (34).

Controlling Capricious Rivers

“I compelled the rivers to flow wherever I wanted, and I wanted them (to flow) wherever it was beneficial. I taught the barren land

In this Gallo-Roman relief, a man transports wine barrels via river. (Source: Wikipedia)

how to be cultivated for I touched it with my own rivers.”
—from Polyaenus’s Strategemata, recounting the triumphs of Queen Semiramis (369)

Rivers are unpredictable, often vengeful creatures. They flood, rage, and destroy. They dry up (seasonably or for long years), leaving land, plants, and people parched. And they change course and move from year to year, silting up, jumping their banks, carving new paths, and shifting their beds often over long distances. Romans, like most humans over the past several thousand years, struggled both to respond to rivers’ variability and to tame their volatility.

The story of Roman rivers is the story of a people (who were very much used to control) striving to regularize waters that were by nature irregular, both to ensure survival and economic benefit and also to manifest power. “Rivers,” Campbell writes, “were among the natural phenomena over which the Romans consciously sought mastery in one way or another. One of the most potent symbols of their control was their ability to take fresh running water from one place and deposit it by aqueduct in the center of a distant city” (30). Roman leaders considered “control over natural forces” and use of “this power to bestow benefits” on their citizens to be core activities of rulership. “Control over a river

Making UNESCO’s list of World Heritage Sites, the Pont du Gard aqueduct crosses the Gardon River in Southern France. (Source: Wikipedia)

[was] a demonstration and confirmation of imperial power"—a broadcasting of the glories of Rome for all to see (369).

Yet, in the final tally and despite extensive building projects (dams, embankments, irrigation systems, drying wetlands), the Roman story of rivers was an "ultimate failure to master them" (13). Indeed, in one of the most intriguing chapters, Campbell describes the extensive legal statutes that existed to deal with the problem of rivers moving and changing course. The laws themselves are evidence enough of the ongoing struggle to "master" rivers.

Who, Roman jurists and surveyors asked themselves, owns the soil that is transported away when a flood comes through a farm? Who owns the land that appears when an island is formed by a river changing course or when years of a river dropping silt leaves behind newly dry land? What compensation can a landholder expect when his land suddenly disappears under water or his fields are cut in half by a migrating river? These questions were pressing because Romans considered rivers public property even as they flowed through and over private lands.

Rivers and the Human Experience

Despite unveiling the remarkably important function of rivers in the Roman world through prodigious research, Campbell's book nonetheless remains less than the sum of its parts. It tells marvelous stories and lays out intriguing and engaging examples

The Aquae Sulis in Bath, England, featuring architectural features above the pillars added later. (Source: Wikipedia)

of the myriad ways in which rivers flowed through the very heart of Roman life. But a larger synthesis and analysis eludes the author.

What, we should ask of Campbell, does all this wateriness mean, not only for our understandings of Roman history but also for today? And what do we learn about the ways in which the human-water interaction defines and channels human life? This latter question is especially important to our present day. How, we should try to learn from the past, will changes in the human relationship to water (and its flora, fauna, hydrology, and geology)

affect present and future human lifeways? The author is unfortunately not forthcoming on these larger questions.

The worlds of Roman rivers remind us that water is more than simply a material object crucial to human life, but also an ever-evolving cultural touchstone that has long stood at the foundation of the human experience. To understand our relationship to water is in many ways to understand the very essence of who we are as a species. ◆

Chapter 2

Climate and a Volatile Earth

Activists march against climate change.
(Source: Flickr by Joe Brusky, Flickr.com)

Climate, Human Population and Human Survival: What the Deep Past Tells Us about the Future

EDITOR'S NOTE:

The controversies generated by climate science in recent years center around the human relationship with the natural world and with natural resources. This month, historian John Brooke puts that critical question in historical perspective—deep historical perspective. For most of human history, our species had to struggle to survive powerful natural forces, like climate and disease. In the past three centuries, however, things have changed dramatically: that struggle has been reshaped by the unprecedented growth of the human population—from under one billion to now over seven. John Brooke's essay forces us to ask whether our population can continue to grow given the current Malthusian pressure on resources and on the earth system itself.

Published May 2012.

By JOHN BROOKE

The melting of glaciers due to global warming is threatening fresh water supplies to human populations in a number of regions. Shown here: Canada's Athabasca Glacier.

In the past few months, extreme weather patterns and a staggering landmark in human population growth combined to give new urgency to the existential question of human prospects on this volatile planet.

The "winter that never was" in North America, as coined by a Canadian magazine, and the unusual cold and snow in Europe coincided with an October 2011 announcement that the global population had reached 7 billion. Taken together, the events raise deep concerns over long-term patterns in the relationship between human population and the earth's climate.

Humanity has been around for a very long time, but in only a few centuries we have grown to vast numbers and transformed our world in unprecedented ways. The very long view of human history—revised in the recent research of climate scientists and environmental historians—uncovers an interesting paradox and offers some sobering conclusions as we chart a course into the future.

Our ancestors lived short, difficult lives, hemmed in by environmental constraints. Whole societies were frequently overturned by sudden, unpredictable, and naturally occurring climatic shifts. In their efforts to survive, our predecessors did little to threaten the earth system that supported them.

We, by contrast, have arrived at the opposite situation: our individual lives are far more healthy and stable, but we have begun to seriously degrade the earth system that supports us. Until recently, we thought we had transcended the environmental constraints that so bounded our forebears. But efforts to break free from the bonds of nature have tended to transform the earth's climate in unpredictable ways.

Across most of human history, overpopulation didn't pose a problem to the survival of the species. Rather, humans stood under the recurring threat of natural disasters, climatic change, drought and famine, and epidemic disease on a scale that we cannot imagine. Until about 300 years ago, every large-scale reversal of human fortunes was driven by such natural forces.

The contemporary world, forged in the revolutionary changes of industry and science that began in the eighteenth century, is fundamentally different. Our vast numbers—7 billion and climbing—have begun to interact with the natural workings of the earth system in complex, unprecedented ways and in a markedly short timeframe.

Geologists are currently debating whether the last 200 to 300 years should be given a new label: the "Anthropocene," the contemporary geological period during which human action significantly reshapes global ecosystems.

We now face the dual danger of an unsustainably large global population that has set in motion a series of changes to climate that—like the many naturally occurring shifts in climate over human history—threaten our civilizations and our existence. Environmental priorities have become far more desperate imperatives in the past 20 years, as we realize that the problem facing humanity is maintaining the essential platform for human life. Life as we know it is changing fast before our eyes.

Deep History: Climate and Human Life before the Great Transition

Let us take a quick look at this sweep of human history and the climate-human relationship on this ever changing planet. Our deep origins lie in the evolutionary history of advanced primates 5 to 10 million years ago. Modern humanity—the species *Homo sapiens sapiens*—was born in the stresses of the glacial cycles of the Pleistocene epoch (which ran from approximately 2.6 million to 12,000 years ago).

Truly modern humans began to emerge around 250,000 years ago, as evidenced by significant shifts in stone tool technology

and the "modernization" of fossil skeletons. Genetics suggests that the earliest modern humans at first comprised a small breeding population, perhaps in the thousands. But they began to grow in numbers and colonize the earth, a process of increase and migration that did not end until Polynesians arrived in Hawaii less than 2,000 years ago.

Over the past three decades, as scientists have sought to establish a baseline from which to measure human-induced climate change, our knowledge about the climate inhabited by our ancestors has advanced dramatically in scope and precision.

Most importantly, scientists and historians have come to realize that, from the great warm-up of the early Holocene (approximately 12,000 years ago) until the eighteenth century virtually every significant transition in the human condition was in some measure shaped by shifting climatic conditions, at times interwoven with the onslaught of disease and epidemics.

Evidence indicates that that there has been a broad coherence in global climatic patterns during the 12,000 years of the Holocene. A warm North Hemisphere has been associated with La Niña conditions in the Pacific and the Americas, and strong monsoons bringing summer precipitation to Asia and much of Africa. Conversely, a cold North Hemisphere has been associated with El Niño conditions bringing storms and flooding to the west coasts of the Americas, and weakening the Afro-Asiatic monsoons.

However, the current warm Holocene period, which is actually an interglacial era, has been punctuated with sharp warmups and coolings that are caused by two distinct climate cycles. The first are "Bond events," discovered in the early 1990s. Marked by great bursts of ice-rafting in the North Atlantic, Bond event sequences appear approximately every 1,470 years and are associated with broadly cooler global climates.

More importantly, the planet also experiences cooling cycles as a result of 2,300-year cycles of grand solar minima, called the Hallstatt cycle (when the strength of the sun on the planet is at a minimum). Three times during the Holocene, this cycle brought centuries of cold, almost glacial climates, most recently in the Little Ice Age of approximately 1300 to 1700 A.D. [See Figure 1]

These climate events molded the fate of the human societies that lived in them.

A major cold event in the 6000s B.C., peaking at 6200 B.C., was a post-glacial episode known as a "meltwater" crisis. It drove the collapse of early agricultural societies in the Fertile Crescent, and their subsequent intensification, as well as the beginning of domestication in the tropics.

The first major Hallstatt grand minimum, in the fourth millennium B.C., ended in intense droughts at 3200-3000 B.C. that launched the first states in Mesopotamia, Egypt, and the Indus Valley. A

burst of El Niño likely launched the first city-states in coastal Peru.

A mystery drought at 2200 B.C., which registered throughout the world but the causes of which are as yet unclear, punctuated the histories of Bronze Age societies throughout the Old World, interrupting them around the Mediterranean, ending an epoch of urban civilization in the Indus and launching the first state in China.

The second major Hallstatt minimum hit around 1200 B.C., with a burst of cold combining around the eastern Mediterranean with what has been called an "earthquake storm." The result was war, famine, and epidemic disease—events that had nothing to do with the pressure of overpopulation, and everything to do with a potent change in the earth system.

This global climatic reversal brought the end of the Bronze Age in southwest Asia and Egypt, and the collapse of the Shang dynasty in China, where climate reversal would bring down dynasties regularly for the next 3,000 years.

Rainfall shifts in this epoch were involved in the establishment of the large villages and towns of "Early Formative" Mesoamerica, which would establish the basis for rise of states. A whiplash of El Niño flooding and drought is similarly seen as establishing the basis for the Early Horizon cultures and the Chavin cult in the Andes.

The ebb and flow of climate over the next 2,000 years—a warm Classical antiquity, a cold Dark Ages, a warm Medieval Regime, and a cold Hallstatt- driven Little Ice Age—interacted with war and epidemic to powerfully shape the fate of cultures and states around the world.

If the details of this history are too complex to even begin to describe here, the lessons of the new climate history seem to be plain.

First, for most of human history, major crises and ruptures in human societies came as a result of climate change, not because of too many people or human misuse of resources. Second, deep human history warns us that when climate patterns did change significantly, the result was societal collapse, war, epidemics, and fundamental restructuring of the geography and structures of human communities.

Ancient and medieval agrarian societies were threatened by under-population, not overpopulation. When populations grew during climatic optimums, they generally managed to achieve incremental improvements to agricultural productivity.

Life was not pleasant. Studies of wealth and income present a persistent pattern of hierarchy and poverty. A peasant family in the late Middle Ages, on average, had a standard of living not unlike that of a peasant family in the Bronze Age, and probably the late Neolithic. Average life expectancy at birth ranged from

This medieval painting titled "The Dance of Death" was inspired by the Black Death pandemic. (Source: Wikipedia, by Michael Wolgemut)

the low twenties to the mid-thirties at best.

But these societies were amazingly durable; they lasted for hundreds of years at a stretch, and then only "collapsed" when hammered by earth system forces. These were crises driven by external factors of the natural environment, not internal pressures of overpopulation or economic practices that degraded their surrounding environment.

The Great Transition: Into the Anthropocene

Beginning in the eighteenth century, changes in human population size and economic activity transformed the long-standing relationship between climate and people.

After the sudden warming that followed the final glaciation of the last Pleistocene Ice Age, by perhaps 9000 B.C., humanity might have numbered as many as 7 million (a guess to be sure, but based on a mountain of evidence). Since that population baseline, humanity grew slowly for thousands of years—generally at rates of less than 0.2% per year, with crises of collapsing populations counterbalanced by occasional surges.

But then, from roughly 1750 forward, the population began to grow at unprecedented annual rates: 0.46%, 0.61%, and 0.64%. Then the growth of human numbers accelerated, hitting 2 billion around 1930 and 3 billion around 1960. During the 1950s, annual growth rates climbed from 1.7% to 1.9%, and then peaked in 1962 and 1963 at a rate of 2% per year.

Since then the rate has slowed to 1.3% per year. Nonetheless, we hit an estimated 7 billion in October 2011: a total population a thousand times greater than the hunter-gather peoples who inhabited the earth after the last glaciation, a mere 12,000 years ago. [See Figure 2]

It helps to put this accelerating history in generational terms. Assuming roughly twenty-five years per generation, there have been 11,000-12,000 generations since the dawn of modern human abilities 250,000 ago, 500 since the end of the last ice ages, 200 since the founding of the first states in 3000 B.C., and perhaps 25 since 1492, the age of Columbus. But there have been only five to six generations since the launch of the modern industrial scientific revolutions around 1870.

Taking place a little more than a century ago, these revolutions brought us household electricity, the internal combustion engine, and modern medicine. These technological and scientific advances, as historian Vaclav Smil has argued, were a fundamental leap, taking humans into a new world utterly unknown to their forebears. The benefits of this revolution to the quality and length of human life have been enormous.

The team led by Roderick Floud and Robert W. Fogel has detailed this era, especially the way that life expectancy has risen dramatically. Where the average age of death around the world in 1820 was roughly 26, it is currently roughly 66, in the high seventies to low eighties for developed countries, and in the mid-fifties for the least developed countries. The increase in life expectancy—driven by our advancing control of disease mortality—is the direct cause of the rise of global population to 7 billion.

Heights and weights of mature adults have also risen dramatically from the late nineteenth century with better nutrition and medical care. An estimated one-fifth of the population of eighteenth-century France was too weak to work; conversely, today's stronger bodies and healthier lives translate into higher and higher levels of intellectual capability and more effective work lives, with progressive cumulative effects on the prospects of future generations.

Across the planet, we are all doing much better than our recent and distant ancestors (although unevenly, with people in certain regions faring better than those in others).

Human Population and the Earth System

But this great transformation has had an enormous impact on the earth system.

No longer simply worrying about a degradation of nature, scientists fear that we are pushing the limits of the envelope that stands between us and the chaos of space. In a little more than a century—in the blink of an eye in historical terms—we have begun to destabilize the workings of the biological, geological, and atmospheric system that maintains life as we know it.

The improved lives we enjoy individually are in direct proportion to how much carbon-based fuel we burn. Carbon dioxide (CO_2) occurs naturally in the atmosphere, and since the end of the ice age it has hovered around 280 parts per million (ppm). But while it occurs naturally, additional CO_2 is a byproduct of the burning of fossil fuels like coal, oil, and gasoline. It is also released when forests are cleared and burned, and even when soil is plowed.

In the middle of the nineteenth century, these levels began to rise, reaching 315 ppm in 1953, the year that I was born. Last year the readings hit 390 ppm, and this spring the monthly averages have been 393 and 394 ppm. Similarly, levels of the more potent gas

Blast furnaces light the iron making town of Coalbrookdale in this 1801 painting, a scene from the Industrial Revolution. (Source: Wikipedia, by Philip James de Loutherbourg)

methane have more than doubled, from a background in the eighteenth century of 700 parts per billion to over 1,750 parts per billion today.

Higher levels of CO_2 and methane in the atmosphere can cause global warming by trapping heat and solar energy, in what is known as the greenhouse effect. [See Figure 2 and Figure 3]

The link between human activity and the levels of these gases in the atmosphere is readily apparent. The rising levels of greenhouse gases in the atmosphere precisely track with the growth of population and gross domestic product over the past century. They also track with the estimates of a rise in industrial emissions from the world economy, which in frightening detail echoes the pulse of expansion, war, depression, expansion, and recession over the recent past. [See Figure 2]

Despite a drum-beat of denial from powerful vested interests, climate change is real and it is upon us. Scientists and policy-makers now debate whether it would be safe to allow atmospheric CO_2 to rise to roughly 450 ppm, a level not seen since before the Oligocene (34 million to 23 million years ago), just as the Antarctic ice sheet began to form. We read daily in the newspaper about the effects of these greenhouse gases: the earth is warming up and changing its systemic behavior.

The oceans, which absorb CO_2 naturally, have reached their limits and are already acidifying, threatening marine food chains already damaged from industrial fishing. Sea levels are rising, putting coastal populations around the world into serious peril from storm surges, and these storms may become more frequent. [See Figure 3]

We are bombarded with news of strange weather patterns: persistent droughts in the American south, flooding in Pakistan, Thailand, the Philippines, and China. These patterns are the signature of the "La Niña" climatic pattern that is suspected in the intensification of Atlantic hurricanes, Pacific cyclones, and Midwestern tornadoes.

And the scientists' greatest fear seems to be unfolding: having predicted that Arctic sea-ice would melt on a gradual curve down to the end of the century, they are finding that it has been melting since the 1970s much faster than their models predicted. Here the concern is the CO_2 and methane frozen in the seafloor and in permafrost under the tundra; already bubbling to the surface, these gases double the greenhouse pressures in the atmosphere in short order.

The actual hard dollar costs of inaction or business as usual are now becoming apparent. Destructive climatic events (compounded by the inevitable tectonic events) already require massive expenditures for cleanup and reconstruction, and these will only get worse as sea levels rise and storms intensify.

Warming temperatures are moving ecological zones northward, and with this shift, tropical diseases will intensify and advance into temperate regions. The breakdown of oceanic food chains is already undermining important food resources, and the shifting and strengthening patterns of drought will seriously affect grain-growing regions around the world. Drought and the melt-off of tropical mountain glaciers are threatening the supply of fresh water to huge populations in several regions around the globe.

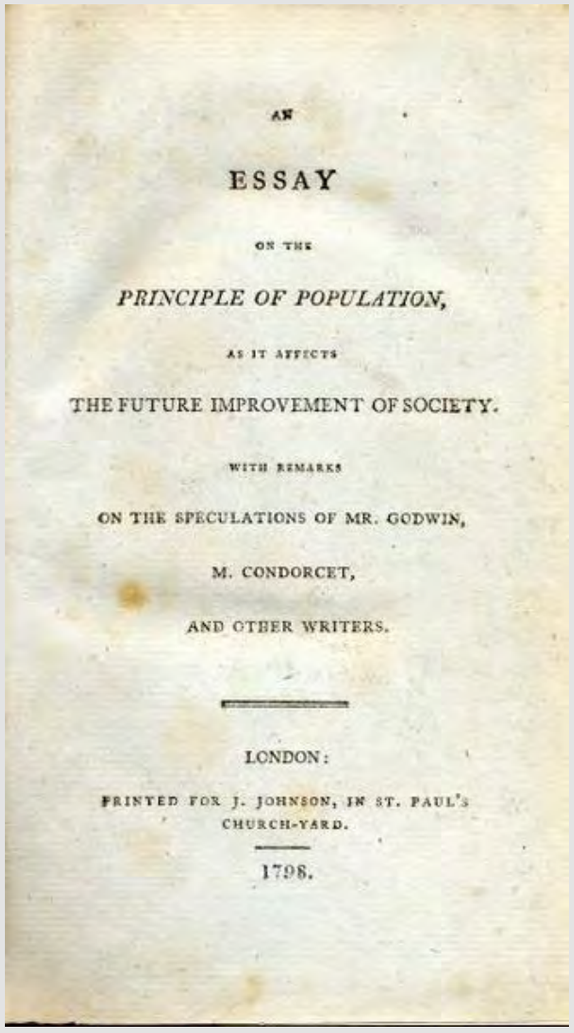
If some interest groups deny the evidence for climate change, other major institutions do not: the escalating cost of managing crises is a dire threat to the insurance industry, which has had to rethink its business models based on now-unstable predictions of natural disasters.

Meanwhile, the military—charged with maintaining a stable environment for American and indeed global economies—is actively planning for a wave of resource wars, water wars, and subsistence wars in the coming decades.

Thomas Malthus (1766-1834), who warned against the dangers of population growth. (Source: Wikipedia)

The Malthusian Model of Environmental History

The Anthropocene constitutes a great human-made rupture with the past—and this rupture has caused historians and scientists to rethink the relationships between nature, climate, and human communities.



AN

ESSAY

ON THE

PRINCIPLE OF POPULATION,

AS IT AFFECTS

THE FUTURE IMPROVEMENT OF SOCIETY.

WITH REMARKS

ON THE SPECULATIONS OF MR. GODWIN,

M. CONDORCET,

AND OTHER WRITERS.

LONDON:

PRINTED FOR J. JOHNSON, IN ST. PAUL'S CHURCH-YARD.

1798.

The title page to Thomas Malthus's famous essay on population. (Source: Wikipedia)

Since the 1960s, a new discipline of environmental history began to address big questions of the changing configurations of nature, population, and economies. From the beginning, environmental historians engaged with the formative thinking of a famous English minister, the Reverend Thomas Malthus.

Looking around him in the 1790s, Malthus was alarmed by a rapidly growing English population, and wrote his *Essay on Population* to sound the warning. Fueled by the natural attraction between the sexes, population could grow geometrically, while the products of the farm could only grow arithmetically, if that.

So Malthus, the good moralist, issued his warning: unless the "preventive checks" of social virtue were applied, fast, the "positive checks" of famine, pestilence, and war would cut human numbers down to size.

It turns out, I would argue, that Malthus was wrong about his past, though very right to be concerned about his present and future.

According to the Malthusian paradigm, ancient and medieval societies lived on the razor's edge of crisis, and were frequently driven into crisis by overpopulation. With the Industrial Revolution, so the story goes, we escaped Malthus's grim reaper through technological advance.

Starting in the 1960s, environmental historians told a different story. Alarmed by the degradation of the natural environment, they began to sound the Malthusian alarm.

Their basic concern is manifested in new calculations of human pressure on the earth's carrying capacity—HANPP, or "human appropriation of net primary productivity": at present humans consume roughly a quarter of the total annual biological activity on the entire globe. These calculations are the essence of the Malthusian paradigm. Human numbers might well overwhelm the biological capacity of the earth to sustain them.

If the first generation of environmental historians attacked the common understanding that humanity had escaped Malthus, they also perpetuated the common understanding that pre-modern societies stood on the razor's edge of Malthusian crisis.

In their telling, the environmental history of humanity was a long series of inevitable crises of population overwhelming local resources. The standard list includes the degradation of soil in Mesopotamia, collapse of Mayan civilization and Easter Island, the Black Death in the Middle age, and the crises that struck across Eurasia in the seventeenth century. These events were moral examples of, in Jared Diamond's words, "societies that chose to fail" by not altering their impact on the natural environment.

I have been teaching environmental history since 1994. For almost a decade I followed the Malthusian orthodoxy of the

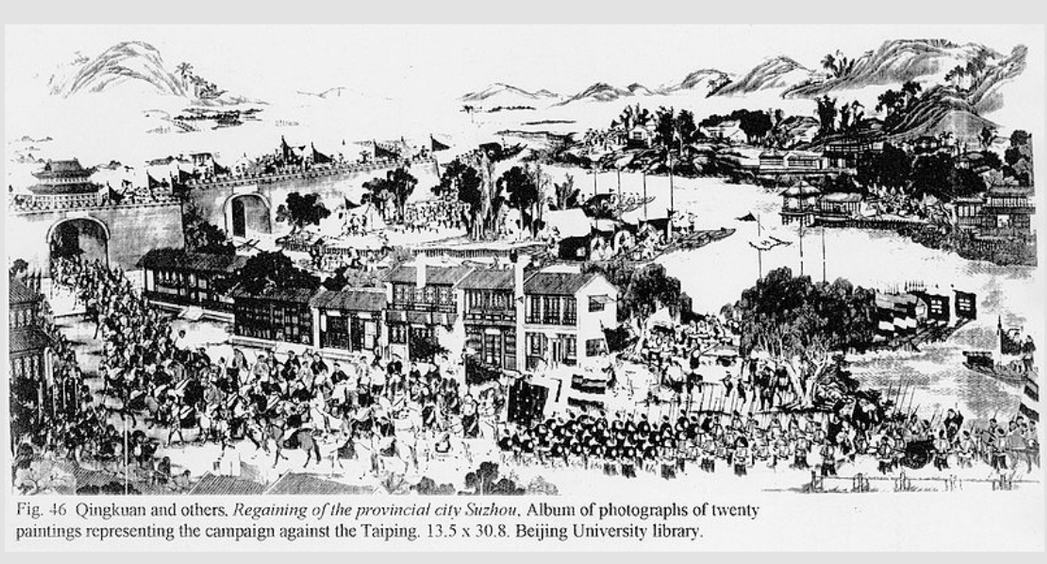


Fig. 46 Qingkuan and others, *Regaining of the provincial city Suzhou*, Album of photographs of twenty paintings representing the campaign against the Taiping. 13.5 x 30.8. Beijing University library.

Scene from the Taiping Rebellion (1850-1864), humanity's first true civilizational Malthusian crisis. (Source: Wikipedia)

founding generation of environmental historians—the human past was filled with Malthusian crises—in which the geometric rise of population overran the ability of limited technology to feed everyone.

Starting in the late 1990s the evidence for abrupt climate change—in climate history, archaeology, and economic history—began to complicate this story. What if these ancient societies were not doing too badly, but the playing field and goalposts changed fundamentally, on scales that they simply could not anticipate?

The Reverend Malthus was right about the world in which he lived: populations in late-eighteenth-century England were indeed growing at an unprecedented rate, as were populations in much of Europe. But China, England, and the United States led the way, England and China with annual rates of 1.3% per year—dwarfed by the surging population advance in eighteenth and nineteenth century America—but well above the healthy global average of approximately 0.6%. Nothing like this had happened before, and Malthus had a reason to be nervous about the press of population.

England escaped the Malthusian calculus through industrialization and imperial reach, and the United States escaped through the conquest of "free" land to the west. China did not escape, suffering a devastating crisis in the middle of the nineteenth century when the Taiping Civil War of 1850-1864 killed 20 million people, perhaps as many as 70 million.

The new climate science—and the insights of a generation of archaeologists and economic historians—suggests that this crisis in China was the first true civilizational Malthusian crisis humanity ever suffered. In fact, it was literally the first in human history that was not, in great measure, the result of abrupt climate change.

Human Prospects on a Volatile Earth

With the new results of climate science, historians know quite a lot about how climates have changed in the past, and the result is a renewed appreciation of the global earth system as an autonomous, exogenous actor in human history. The ways in which naturally induced climate change radically transformed human existence in past millennia is a wake-up call to the prospects of similar convulsions as a result of the contemporary, human-induced climate transformations.

At the same time, the long perspective of climate history allows us to reconsider the Malthusian calculus, and it highlights the burgeoning, unprecedented crisis of population we now face.

Ancient populations suffered poor individual life outcomes, with poor health and low life expectancy; conversely, they imposed relatively low environmental impact and enjoyed long-term societal sustainability. Whatever their flaws, ancient societies should not be condemned for failings of environmental consciousness.

Modern populations, by contrast, enjoy excellent individual outcomes, with amazingly good health and high life expectancy (even if varying geographically), but are causing systemic changes to the entire global ecology. Whether these changes are sustainable is very much an open question.

In the life spans of the past five to six generations, the double-edged sword of science and industry has carried humanity through a great and paradoxical transition to prosperity and peril. After two decades of sounding the warning, most in the scientific community are exhausted and depressed.

Throughout the world people attuned to the perils upon us are sobered by how much it will cost and how long it will take to construct a new energy system to fill the place that fossil fuels now occupy in the delivery of essential services to massive new populations around the world. Close to home, despite the fact that Americans per capita consume roughly twice the hydrocarbons of anyone else in the world, there is no sign that we are willing to voluntarily restrain ourselves.

The fertility transition that has begun to slow the rate of global population growth is a hopeful sign. Certainly much of the reduction of fertility has come by government fiat in China, but it is notable how in many countries—India, Iran, Bangladesh stand out as examples—the classic transition of educating women and raising aspirations has reduced the pressure of new births to the

point that experts see population growth rates stabilizing and reversing in the coming decades.

On the climate front, the Montreal protocols to control ozone-depleting CFC emissions have been a great success since they went into effect in 1989, and this experience stands as a model for the control of carbon dioxide and other greenhouse gases.

Attention is now being focused on strictly controlling methane and black soot—the most extreme and volatile elements of the greenhouse gases emitted by the global economies. Getting these under control might make significant differences, buying time for longer-range shifts to take effect.

Whatever the future holds, it is coming at us with breakneck speed. And just as a long historical horizon allows us to look back at the circumstances of previous generations, it demands that we think forward to the fortunes of generations to come. ◆

Suggested Reading

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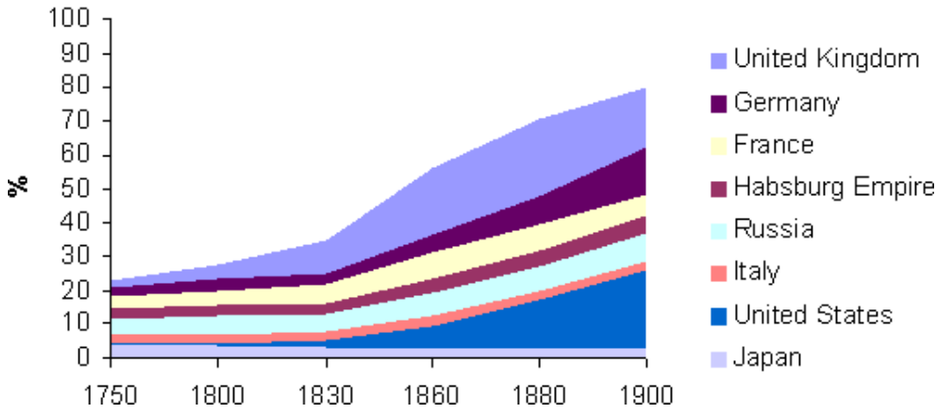
Gary Wilder, *The French Imperial Nation-State: Negritude and Colonial Humanism between the Two World Wars* (Chicago: University of Chicago Press, 2005).

Ibrahima Diallo, *The Politics of National Languages in Postcolonial Senega*l (Cambria Press, 2010).

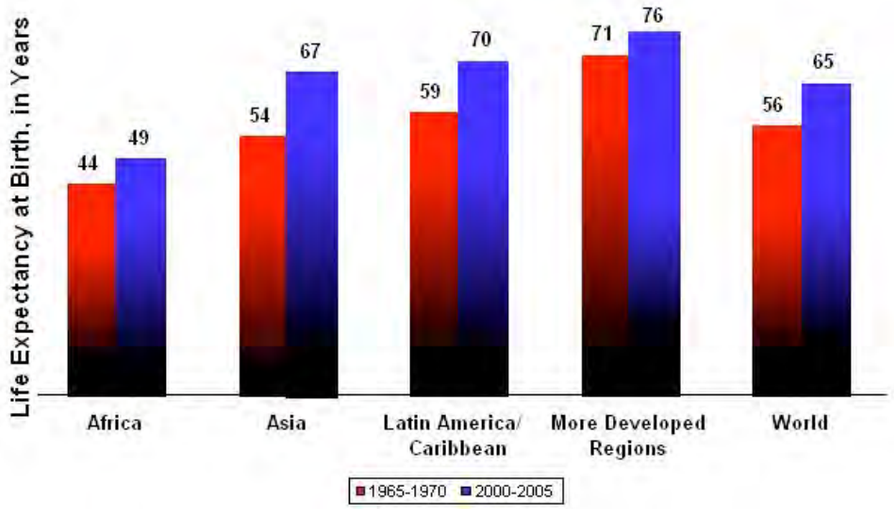
Maps and Charts

Shares of world manufacturing output, 1750-1900



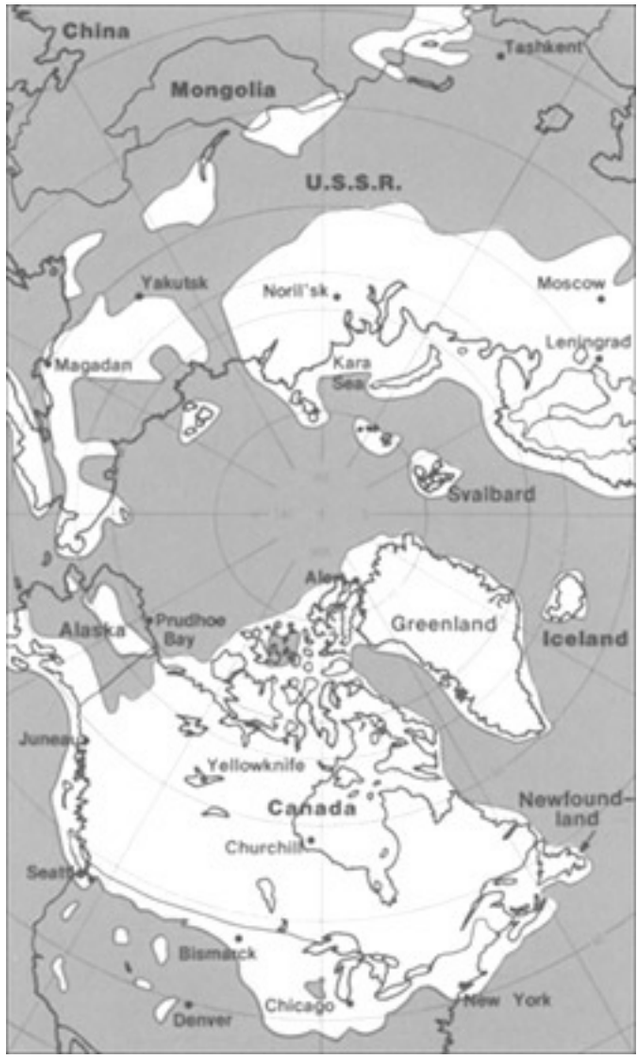
(Source: Wikimedia)

Trends in life expectancy by region, 2002



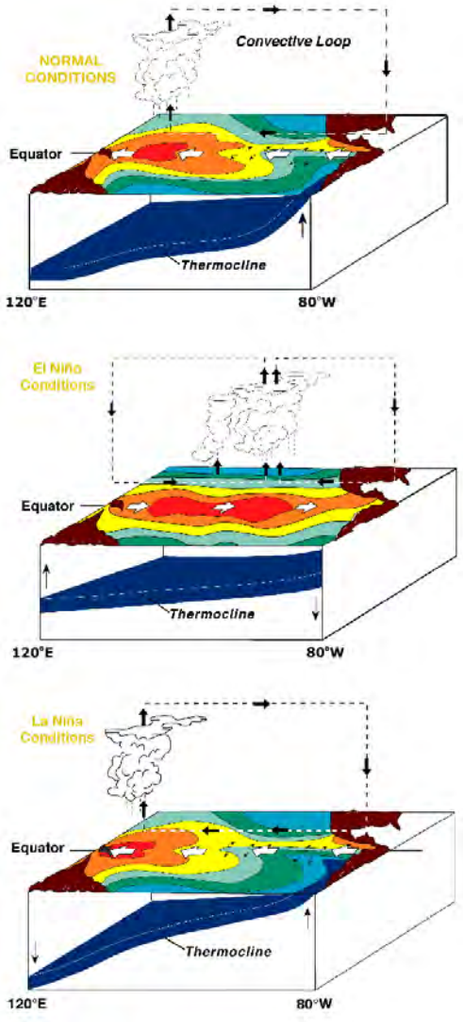
(Source: United Nations)

The maximum extent of glacial ice in the north polar area during the Pleistocene era



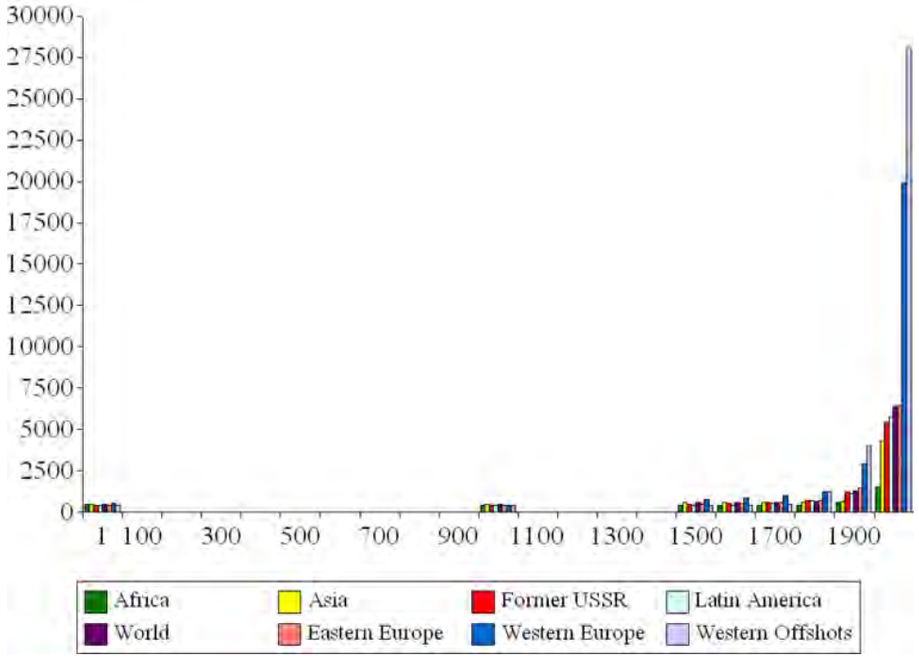
(Source: U.S. Geological Survey)

Weather conditions caused by El Niño-Southern Oscillation (ENSO) and La Niña conditions



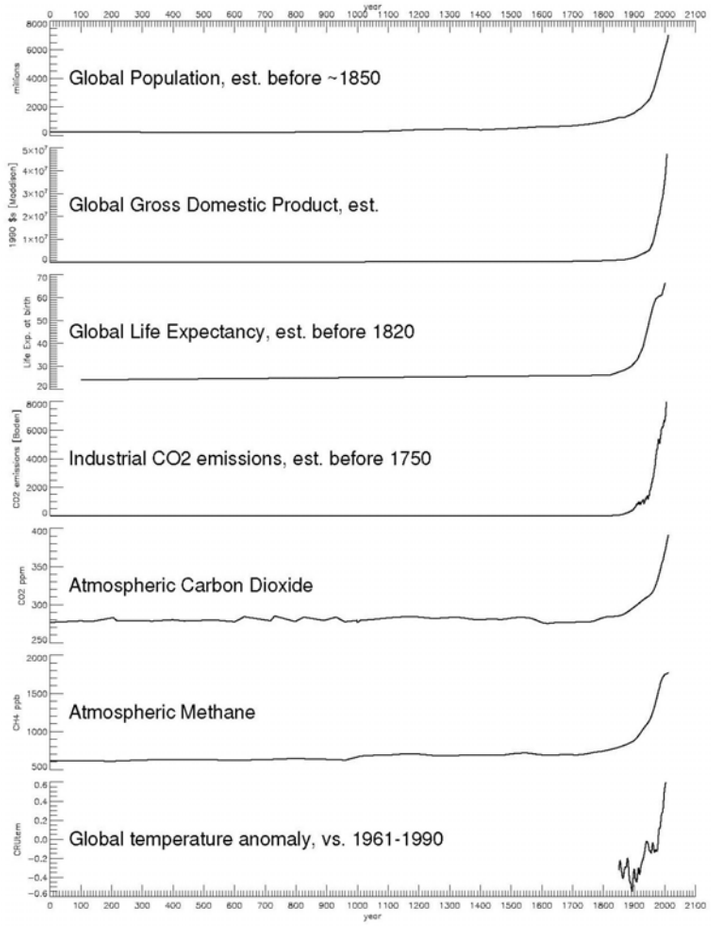
(Source: National Oceanic and Atmospheric Administration)

World GDP per capita, 1-2003 A.D.

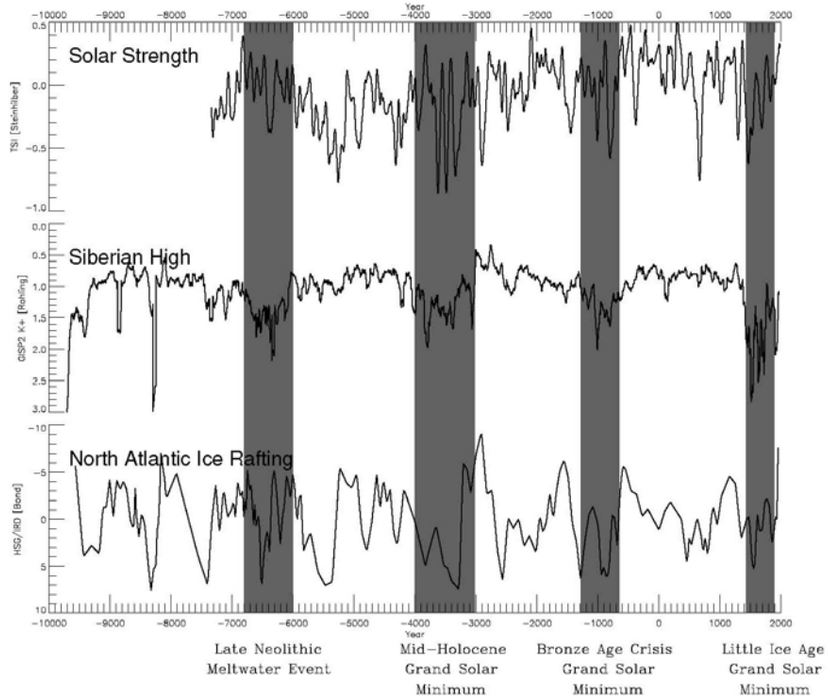


(Source: Wikimedia)

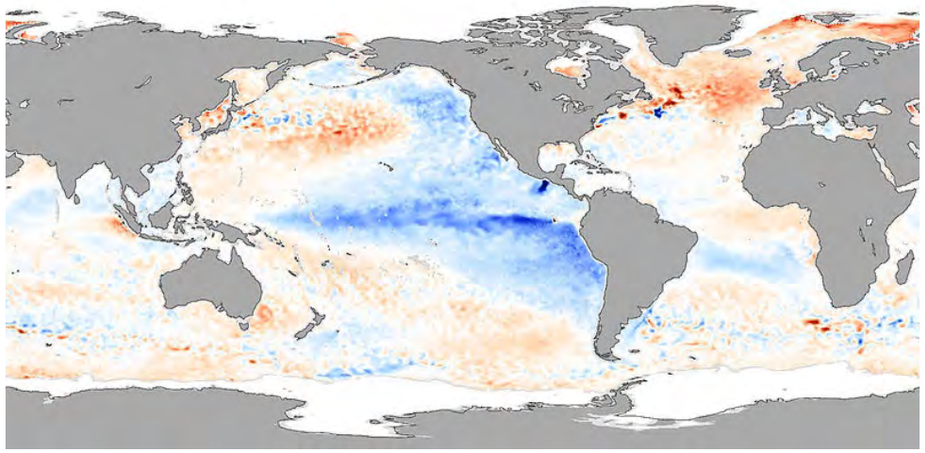
Various measures of global health and economy show a sharp increase around the time of the Industrial Revolution, mirrored by rising levels of CO2 and methane in the atmosphere



Climatic events that changed the course of human history in the deep past, especially solar strength and Atlantic ice rafting

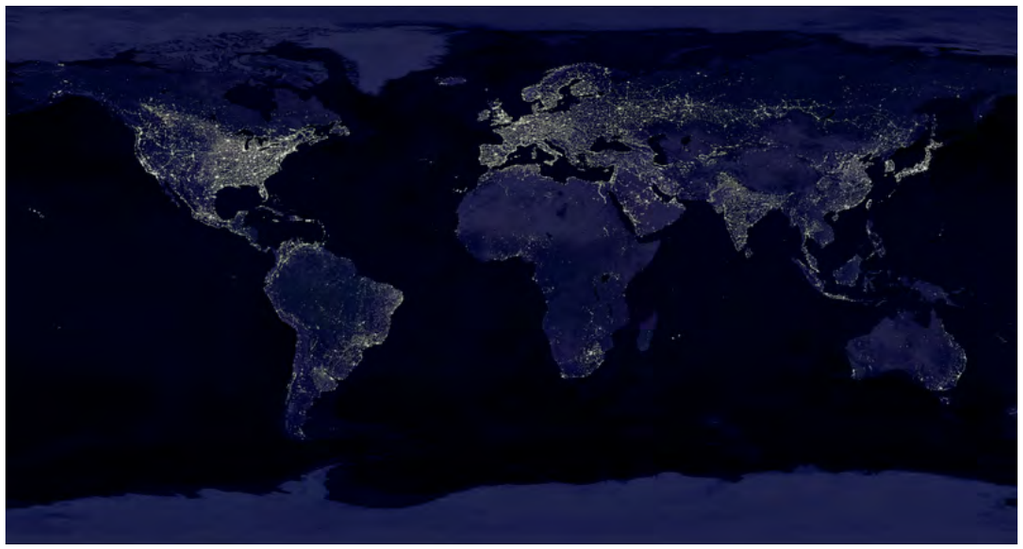


2007 sea surface temperatures reflect La Niña weather patterns



(Source: NASA Earth Observatory)

"Nighttime Lights of the World" photo composite from satellite images

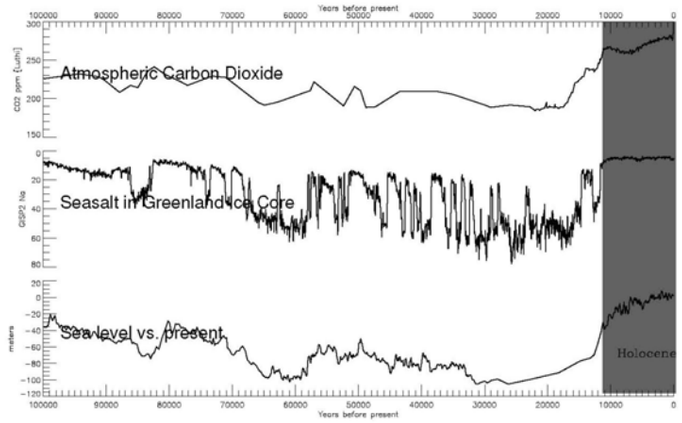


(Source: Wikimedia Commons)

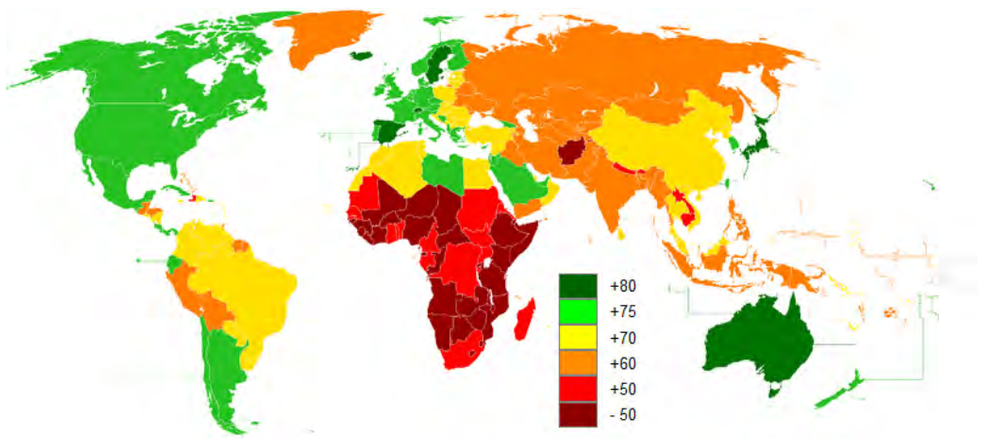
Location of the Chavin cult in the Andes Mountains, 900-200 B.C.

(Source: Wikipedia)

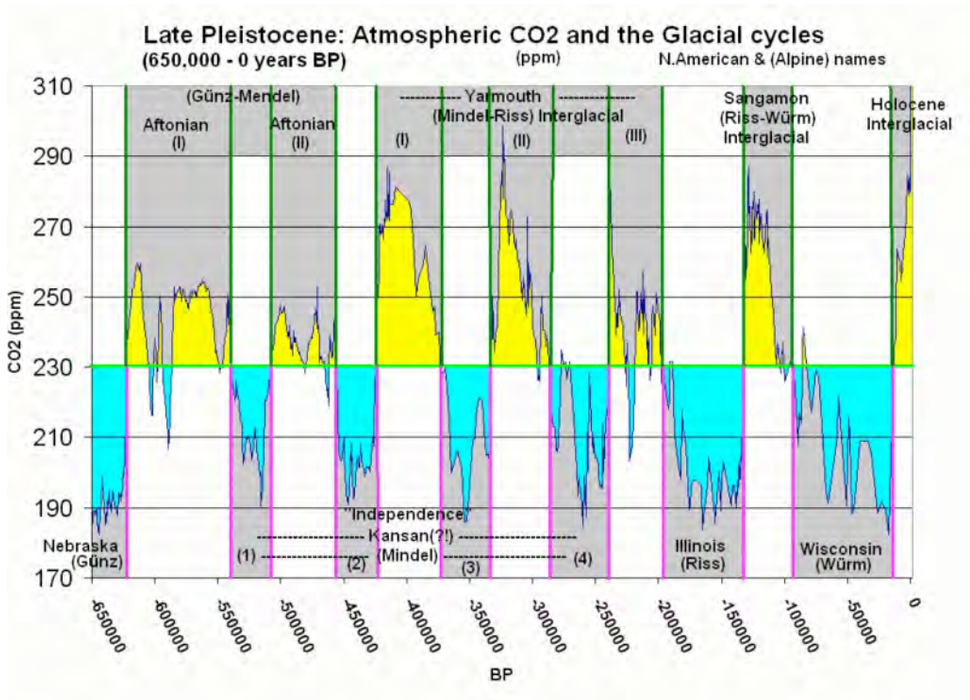
Major changes to global climate measures before and during the Holocene period, highlighting CO2 and sea levels



Worldwide life expectancy in years



Ice core data for atmospheric CO2 related to the glacial cycles



(Source: Wikipedia)

Additional Image

1881 post card of a German industrial site

Section 2

Russia and the Race for the Arctic

EDITOR'S NOTE:

Global climate change has caused unprecedented changes to the Arctic environment, especially a rapid decrease in the summer sea ice sheet. While perilous to the survival of the iconic polar bear, many humans are watching these changes with an eye to what riches an open Arctic Ocean might bring forth: in oil and gas, mining, and open-water transportation. Five countries can lay claim to the potential wealth of the Arctic Ocean: Canada, Denmark, Norway, Russia, and the United States. But it is Russia and Canada in particular that have jumped out to the early lead in this new race for the Arctic. This month, Nicholas Breyfogle and Jeffrey Dunifon explore Russia's long history in the Arctic and the roots of its current assertive policies in the region.

Published August 2012.

**Update: you can find an interview with one of the authors, Nicholas Breyfogle, on climate change at our podcast Writers Talk History.*

By NICHOLAS BREYFOGLE and JEFFREY DUNIFON

On a sunny day in late April 2003 at a site about 150 km from the North Pole, Artur Chilingarov, famed polar explorer and member of the Russian parliament, straightened his arm into the air, fired his pistol, and declared: "This is our Arctic, this is the Russian Arctic, and the Russian flag should be here."

Huddled together for warmth, a dozen Russian explorers had just raised their national colors, ceremoniously opening the first Russian polar research station in the Arctic since the collapse of the USSR in 1991.

Artur Chilingarov wearing the Star of Russia, awarded to him by President Vladimir Putin for his work. (Source: Wikipedia)

Known as North Pole-32, it was the thirty-second drift monitoring station Russians had set up on the Arctic ice since 1937. As the ice flowed and moved, the scientists stayed at the outpost until March 2004, when the ice destabilized, shooting up huge ridges, destroying the camp, and requiring a rescue evacuation. Before disaster struck, they conducted wide-ranging scientific research on weather, ice, temperature, Arctic

biology, and navigation.

Though the world largely ignored Chilingarov's words and actions at North Pole-32, he would again publicize Russia's claims to the Arctic in 2007. This time, everyone took notice.

Miles below the site of his previous declaration, a MIR submersible carried Chilingarov and two others to the Arctic seabed, the first time humans had done so at the North Pole.

There, 14,000 feet (2.5 miles) below the ice, the submersible collected rock samples and planted a titanium Russian flag.

The international response was immediate:

Canadian Foreign Minister Peter McKay exploded. "This is posturing. This is the true north strong and free, and they're fooling themselves if they think dropping a flag on the ocean floor is going to change anything. There is no question over Canadian sovereignty in the Arctic. We've made that very clear. We've established—a long time ago—that these are Canadian waters and this is Canadian property. You can't go around the world these days dropping a flag somewhere. This isn't the 14th or 15th century."

John B. Bellinger III, legal adviser to the U.S. Secretary of State, remarked: "We knew they were going to the North Pole, but we didn't know they were going to plant the flag. It was a provocative action, and took us aback."

The western press echoed the outrage: a "stunt fueled by a return to czarist impulses;" a "Kremlin-sponsored act of bravado aimed at boosting national pride."

Russian President Vladimir Putin sounded a note of conciliation: "Don't worry. Everything will be all right. I was surprised by a somewhat nervous reaction from our Canadian colleagues. Americans, at one time, planted a flag on the moon. So what? Why didn't you worry so much? The moon did not pass into the United States' ownership."

Chilingarov, by contrast, wasn't above fanning the flames of nationalism in public. "It's only natural that our dive had great patriotic impact, and of course we planted the flag, as Americans would do in a similar case. I don't understand why there is all this noise in the international community. If anyone wants to plant a flag down there, they're welcome to. There's plenty of room."

In Moscow, he told a group of well-wishers, "I don't give a damn what all these foreign politicians … are saying about this. If someone doesn't like this, let them go down themselves and try to put something there. Russia must win. Russia has what it takes to win. The Arctic has always been Russian."

Putin's successor, President Dmitry Medvedev, put to rest any lingering doubts over Russia's aspirations in the Arctic in a 2009 speech to Russia's Security Council: "This is our responsibility, and simply our direct duty, to our descendants. We must surely,

and for the long-term future, secure Russia's interests in the Arctic."

The New Race for the Arctic Waters

While McKay and others might see Chilingarov's flag as anachronistic, they cannot ignore the competition now underway for control of the Arctic.

Arctic land regions were divided among state powers centuries ago. The current race is for dominion over the waters and ice of the Arctic, especially the resources that might lie beneath the ocean floor. The Arctic Ocean is "the last piece of non-jurisdictional real estate on the planet," as one journalist wrote.

The scramble for the Arctic involves five nations that have a claim to the Arctic Ocean through the UN Law of the Sea, now known as the A-5: Russia, Canada, the U.S., Denmark (via Greenland), and Norway.

Three other countries, Sweden, Finland, and Iceland, have territory in the Arctic Circle but with no Arctic Ocean coastline, they have no treaty claim to the ocean. The A-5 plus these three form the core of the Arctic Council.

Most have made recent moves to shore up or enhance their interests in the Arctic and to delineate international boundaries of control. But Canada and especially Russia have been the most active and thoughtful. The United States, by contrast, has been slowest off the blocks.

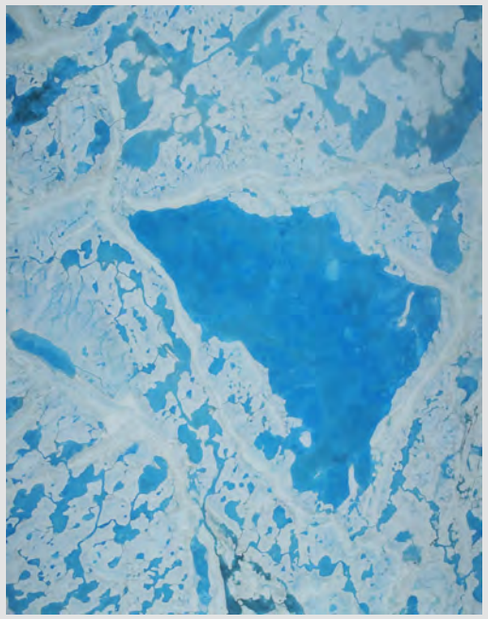
Canada held its largest ever military exercises in its northern regions in 2011, is investing in Arctic patrol ships, and has announced plans for a new deep-water port at Nanisivik. Prime Minister Stephen Harper has led a public relations campaign to remind the world of Canada's historic and current interests in the Arctic, carrying out regular summer trips to the north.

Canadian HMCS Goose Bay moored at the future site of the Nanisivik Naval Facility, during Operation Nanook, in August 2010. (Source: Wikimedia Commons)

Norwegian oil companies have been rapidly expanding their drilling operations in the Arctic Ocean, and Norway too has significantly boosted its military presence in the Arctic. In 2008, it

took part in a NATO training exercise in which a fictional country called "Northland" seized offshore oil rigs in the Arctic. Russia was not amused.

Denmark has expanded its military budget for the Arctic and worries that this race will accelerate demands for independence from Greenland. In 2009, the U.S. Coast Guard began to speak of a policy shift from "scientific research" to "security and sovereignty" in the area.



NASA aerial view of melting arctic sea ice. (Source: Wikimedia)

Three recent events have accelerated interest in the Arctic region on the part of all of these countries: global climate change in the Arctic region and the melting of sea ice; the promise of extraordinary economic gain from ocean-floor resources such as fossil fuels and minerals and from global shipping across open Arctic waters; and finally, the regulations of the 1982 UN Convention on the Law of the Sea (UNCLOS; also known as LOST, for Law of the Sea Treaty).

The relative response of the five different participants to these three processes—and particularly Russia's assertive actions in the region—has a lot to do with each country's historic relationship to the Arctic region.

Since at least the fifteenth century, Russia (much like Canada) has been an active, self-consciously Arctic nation. The current competition is reawakening a profound Russian connection to the Arctic.

As the historian John McCannon has written, "for as long as Russia has existed as a country, and particularly during the twentieth century, the Arctic has occupied a place of prominence in its national development."

Arctic territory makes up in the range of 25% of the Russian landmass, holds a disproportionately large part of the country's natural resources, and was strategically important during the Cold War, when the Arctic space represented the closest point between the U.S. and the USSR.

But it is in the cultural realm that the Arctic has come to capture the Russian imagination. Polar explorers—especially the Soviet-era pioneers from the 1930s, who led the world in Arctic exploration—hold a fame and popularity unmatched elsewhere in the world.

Chilingarov, in his recent exploits, harkens back to the days when Russians were path breakers in Arctic exploration, development, and derring-do. With similar pride and patriotism, today's Russian Arctic specialists aspire to lead the world into the Arctic era of the

twenty-first century, with its resource wealth and strategic advantage.

Heroes of the Arctic: A Russian Love Story

Despite the many contemporary incentives in staking an Arctic claim, Russia's forward policy in its northern waters is not solely the result of recent events. Its long and deep connection to the frozen north helps to explain why Russia has exhibited a much greater vigor than the other countries in the race, despite the benefits at stake for all involved.

Before the space race and the race under the oceans, there was the race to explore the far extremes of the planet, from its frozen poles to its highest peaks. The Russians who explored (and explore) the Arctic reached an enduring celebrity status, especially during the Soviet period and even when the expeditions ended in disaster.

Russia's Great Northern Expedition of the early 18th century was the greatest scientific expedition in scope and size that the world had seen to that time and the first illustrious chapter in the story of formal Russian Arctic exploration. One contingent mapped and explored the navigability of the Arctic shoreline, with trade and strategic goals in mind, others gathered volumes of scientific data, and others still went in search of the North American continent (making Vitus Bering a household name).

But in the 1920s and 1930s, the cult of the Arctic and the Arctic hero took off. It was personified in Otto Shmidt—whose resume was filled with seminal achievements, honors, and global renown—and also the Soviet Union's Arctic pilots. For their record-breaking flights over the Arctic region, they received international acclaim and, in the Soviet Union, rose to a level of stardom only enjoyed by the likes of Charles Lindbergh in the United States.

Famed Russian explorer Otto Shmidt. (Source: Wikimedia Commons)

For Shmidt, his rapid rise to Arctic superstardom began with the 1932 expedition of the ship *Sibiryakov* that proved the single-season navigability of the Northeast Passage—or, as the Russians call it, the Northern Sea Route (NSR).

Dreams of the Northeast and Northwest passages (the latter across Canada's north coast) to transport goods from Europe to Asia through the Arctic Ocean had tantalized European leaders

Participants of the North Pole-1 expedition. Otto Shmidt is in the middle, with one of the airplanes that they landed at the North Pole. (Source: Wikimedia Commons)

and adventurers for centuries, and led many explorers unsuccessfully into the unforgiving frozen north.

Since the 17th century, Russian explorers set out to navigate their northern shores only to see their shallow, small wood vessels crushed into kindling by the moving ice.

With the advent of steam and steel, Swede Adolf Erik Nordenskiöld first crossed the Northeast Passage in 1878, but required more than one sailing season to make it across.

Finally in 1932, during a relatively ice-free summer, Russian sailors aboard the *Sibiryakov*, led by Shmidt and Captain Vladimir Voronin, made it across the NSR in a single sailing season for the first time in recorded history.

The Cheliuskin Rescue

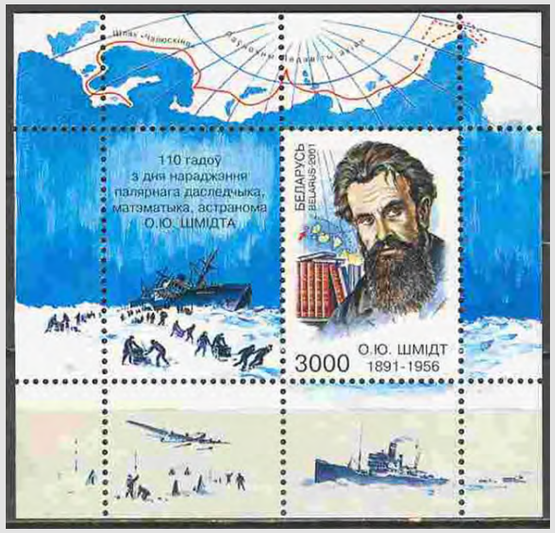
Following the success of the *Sibiryakov*, Shmidt then led the *Cheliuskin* mission, which was to traverse the same route with the goal of further substantiating the economic viability of the NSR. The *Cheliuskin* voyage remains today one of the most dramatic rescue missions in Russia's history.

For reasons that remain unknown, the ship was of decidedly un-Arctic design. Not an icebreaker, it had a wide, thin, square hull. It was probably used because the vessel was large and

The Cheliuskin sinking in 1934, crushed by the Arctic ice. (Source: Wikimedia Commons)

inexpensive, but it was a huge gamble for the savings.

Despite the substantial shortcomings of the vessel, the voyagers embarked on July 12, 1933. By mid-October, the ship was trapped in ice. Although they considered leaving the vessel and traveling over the ice to safety, the crew decided to remain aboard. Anxious leaders in Moscow hoped that the ice would eventually flow out to the open Pacific Ocean and free the ship.



2001 Belorussian stamp set commemorating 110 years since the birth of Otto Shmidt. The stamps depict his Arctic triumphs: Northern Sea Route, Cheliuskin rescue, North Pole-1, Arctic flight. (Source: Wikimedia Commons)

By February 1934, the ice imprisoning the vessel began to crush its hull. The crew practiced evacuation drills, and their preparation paid off. During the two hours or so it took the ship to sink, all the gear the explorers would need to survive in the Arctic was unloaded. Though one crew member perished in the sinking, the remaining 104 people were left stranded on the Arctic ice.

Time was of the essence if the survivors were to be rescued, and the authorities chose to attempt a never-before air rescue in the Arctic.

In March, aviator Alexander Liapidevsky touched down at Camp Shmidt—as the settlement was christened—on a primitive airstrip made on the ice by the stranded crew. By April 13, Shmidt flew out with the last of those on board.

The *Cheliuskin* rescue made the Arctic explorers and pilots into national heroes and global celebrities, and deeply embedded the Russian fascination with the Arctic. The fanfare in the press turned a brave and ambitious, but otherwise unspectacular and ill-fated, mission into a tale of national triumph.

They became symbols of the excellence of the Soviet Union, and they were highly decorated with medals and honors. On May Day, pictures of them were held up alongside of likenesses of Lenin, Stalin, and Mikhail Kalinin. Even in the U.S., the *New York Times* described the events as a "brilliant chapter in the history of human struggles against Far Northern elements."

Shmidt travelled through the U.S., speaking on national radio networks and meeting with eminent figures including President Franklin Delano Roosevelt.

North Pole-1: Technical Achievement and National Competition

In the wake of *Cheliuskin*, Shmidt and his fellow Arctic explorers and scientists embarked on a series of daring and groundbreaking Arctic projects. These included the establishment

of the world's first research base on the Arctic ice, North Pole-1—from which recent North Pole stations are direct descendants—and a program of "first" trans-polar flights by the Soviet Union's daring pilots.

The technical and scientific achievements of the Soviet Union's Arctic endeavors in the 1930s fed the national fascination with the Arctic. Their exploits and scientific triumphs became a yardstick of the Soviet Union's eminence under the Stalinist regime, just as they are in today's Russia.

Conceived by Shmidt, the idea for North-Pole-1, was, from its inception, about unique, technological brilliance.

Russian stamp commemorating the 1937 North Pole-1 research station. (Source: Wikimedia Commons)

By the time the mission was underway in 1937, the race to reach the pole had been over for decades, at least outside of Soviet borders. The last trip to the pole occurred in 1909, when the American Robert Peary claimed to have been the first to reach it.

North-Pole-1 would have a decidedly different focus. If the explorers could not be the first to travel to the North Pole, they would be the ones to do it in the grandest technological and scientific fashion.

Their mission was two-tiered. First, Shmidt would arrive at the pole by way of aircraft. Though the feat of flying over the pole had been achieved, the prospect of landing an aircraft there had yet to be attempted.

Second, the mission would establish the first research station at the North Pole. The station would start operation at the North Pole but as the ice moved over time, it would gradually drift towards the Atlantic, where the scientists would be retrieved by boat.

In May 1937, Shmidt and his crew landed at the North Pole as planned and began constructing their weather-monitoring station.

The mission was immediately given worldwide media attention. A contemporary *New York Times* article covering the event emphasized the speed and foresight with which the Soviets had set up their base for research, their breaking of records, and their "great contribution to world science."

Soviet sources were also quick to draw comparison to their successful employment of technology for science and peace. Their air flights to the North Pole stood in stark contrast to the Nazi German employment of warplanes to demolish Spanish cities. The disastrous case of the Hindenburg was also contrasted against the North-Pole-1 victory.

With the *Cheliuskin* rescue and the landing at the North Pole, the miracle of flight was already becoming a central component of the Soviet Arctic epic. Trans-polar flights from Russia to America further transformed the Soviet Union's stable of brave pilots—including Valery Chkalov, Sigismund Levanevsky, and Mikhail Gromov—into national and worldwide celebrities.

Russian President Vladimir Putin aboard an exploration vessel on the Barents Sea in 2005. (Source: kremlin.ru)

On June 8, 1937, Chkalov became the first to transverse the pole, flying more than 5,288 miles over a period of 63 hours from Moscow to Vancouver, Washington. In doing so, he had set a world record and completed the first trans-polar flight between Russia Mikhail Gromov followed up on this success by flying 6,305 miles to San Jacinto, California.

Though the final flight, of Levanevsky, ended with a disastrous crash, Russia's aviation exploits remained symbols of personal heroism and national achievement.

Arctic researchers, explorers, and scientists have remained prominent public figures ever since. In the surge of Russian Arctic research efforts over the last decade, there are clear and

Three polar bears approach the starboard bow of the submarine "USS Honolulu" while surfaced 280 miles from the North Pole in 2003. (Source: Wikipedia)

conscious echoes of the heroism and adventure of the Soviet Arctic in the 1930s.

Referring to the 2003 establishment of North Pole-32, Putin declared: "It is very important that after a break of 12 years, Russian scientists return to the North Pole to continue the remarkable traditions of the legendary polar explorers."

Chilingarov's Arctic endeavors (and showmanship) and the reestablishment of the North Pole drift research stations (now North Pole-39) reflect the ongoing Russian attachment to Arctic

research and exploration, the lionization of the Arctic explorer (even in catastrophe), and the special place that the Arctic holds in the Russian heart and spirit.

Adieu Polar Bears: Climate Change and the Arctic's Disappearing Ice

Global climate change offers a rapidly changing landscape for today's generation of Russian Arctic specialists, and is affecting the Arctic region disproportionately. The most recent reports indicate that the Arctic is warming at least twice as fast as the rest of the planet.

Over roughly the past 20 years, the summer ice sheet's cover shrunk by more than 20 percent and has thinned significantly. According to a 2009 National Oceanic and Atmospheric Administration report, that decrease is expected to at least double by 2050.

A recent report commissioned by Lloyds noted: "In September 2011, the month when Arctic sea ice extent is typically at its lowest, ice coverage fell to a low of 4.33 million square kilometers (1.67 million square miles), some 2.38 million square kilometers less than the 1979–2000 average."

Predictions are constantly changing—and vary from one scientific group to another—but observations consistently show an acceleration of the melting of sea ice far greater than anyone imagined even a few years ago.

A 2004 report compiled by 250 scientists at the request of the Arctic Council stated that Arctic sea ice could completely disappear as early as 2070. Many studies now suggest that the Arctic Ocean will be ice-free for a portion of the summer as soon as 2030.

Just this past June, scientists witnessed in the Arctic an "enormous, off-the-charts" bloom of phytoplankton—something so unusual that scientists, according to Paul Bontempi of NASA, "never, ever could have anticipated [it] in a million years."

Such unpredictability, rather than reining in aspirations in the Arctic, has created even more incentive for the five countries in the race to the Arctic.

An Ocean of Riches?

The A-5 countries have begun seeking profits from the disappearing ice. The opportunities for economic gain appear clearest in resource development (especially extractable resources such as oil and natural gas) and shipping.

According to 2008 U.S. Geological Survey data, the Arctic contains some 412.2 billion barrels of oil and oil equivalent: an "estimated 90 billion barrels of undiscovered, technically recoverable recoverable oil, 1,670 trillion cubic feet of technically recoverable

natural gas, and 44 billion barrels of technically recoverable natural gas liquids."

These amounts represent about 30% of the estimated undiscovered natural gas (approximately equal to Russia's proven natural gas reserves today) and 13% of the global estimated undiscovered oil (about three times the U.S.'s proven oil reserves currently).

Russian sources put the resource potential much higher than the USGS: Arctic-Ocean territory claimed by the Russian government could contain as much as 568 billion barrels of oil and oil equivalent, they believe. While this data is only speculative, it is more than twice the oil reserves of 260 billion barrels in Saudi Arabia, the owners of the world's largest proven reserves.

In 2007, the Oxford Institute for Energy Studies reinforced these higher numbers, asserting that "Russia's extractable offshore hydrocarbon resources are approximately 100 billion tonnes (about 740 billion BOE), 80 percent of which are located in the Arctic."

These high estimates of energy potential make it clear that the melting ice might make this region into a new Gulf of Mexico, ripe for offshore drilling. Experts also believe that the Arctic region contains diamonds, gold, tin, manganese, nickel, lead and platinum, among other minerals.

And the irony is lost on no one that fossil fuels—a primary culprit of global climate change—will be a windfall of the melting ice.

Shipping: The Northern Sea Route

The potential wealth of the Arctic also lies in the possibility of a revolution in shipping.

For Russia, the decrease in Arctic summer ice has begun to open up the NSR for a larger volume of transport over a longer part of the summer (now eight or more weeks of the year). Shipping traffic rose rapidly in 2010 and 2011, with another likely increase in 2012.

Travel along the NSR (as across Canada's Northwest Passage) saves an average of about 5,000 miles compared to current routes.

To take one example, travel from Murmansk in Russia to Yokohama, Japan would save approximately 20.5 days of travel via the NSR versus taking the existing route through the Suez Canal (only 5750 nautical miles versus 12,730 Nm)

When the *Vladimir Tikhonov* made its historic voyage through the NSR in summer of 2011—at 162,000 tonnes, by far the largest ship ever to navigate the northern waters—it reduced the distance travelled from Murmansk to Thailand by 40% and cut off about a week from the time it would have taken to travel the usual route through the Suez Canal.

Russian nuclear icebreaker "Yamal" on its way to the North Pole, carrying 100 tourists, in 2001. (Source: Wikipedia)

If summer Arctic ice were to disappear entirely, the passage that would then open up directly over the North Pole would save an average of 8,000 miles.

Although commercially viable trade across the NSR is likely as many as 15-20 years away, Russia is already asserting its claim to the northern seaways and the ocean's economic benefits.

The NSR would make it cheaper and more efficient for Russia to move its mineral and fossil fuel resources, making the Arctic a "global energy corridor" or a "floating pipeline" of Russian oil and gas, as analysts have described it.

Russia is also investing heavily in shipping services and infrastructure in the north in the hopes of reaping profit from others transporting their goods through the region: through levies, fees, permits, shipping re-supply stations, and ice breaking (with average escort cost through the Arctic currently at $200,000).

Russia is banking on shippers around the world realizing the economic benefit of the NSR. "I want to stress the importance of the Northern Sea Route as an international transport artery that will rival traditional trade lanes in service fees, security and quality," Putin said in 2011. "States and private companies who choose the Arctic trade routes will undoubtedly reap economic advantages."

The opening of regular navigation across the NSR would also permit Russia more easily to defend its extensive coastline and eastern shores by allowing the navy to move ships from one end to the other without having to go the long way around through Suez.

There are obstacles to the northern shipping route, however. Even with rapid warming, there still remains ice cover for large parts of the year, requiring expensive ice breakers, and the northern ice currents are legendarily difficult to navigate. Consumer markets

do not tolerate the uncertainty of exactly when the shipping season will start.

And there are already strong environmental movements focused on protecting the relatively pristine Arctic waters from the oil spills and other pollution problems that are sure to follow in the wake of increased transport.

LOST at Sea

Russian interest in the Arctic Sea, as for the other four A-5 states, has also been pushed forward at an accelerated pace because of the UNCLOS treaty and its provisions, which were adopted in 1982 after a decade of negotiations. Among the many provisions in this "constitution for the oceans," the treaty established just how far the jurisdictional rights of each sovereign state extend into the ocean.

All states are granted a 12 Nm territorial limit and a 200 Nm (370 km) exclusive economic zone (EEZ), in which a state has rights over the water, fish, and any seabed resources.

UNCLOS also permits countries to extend their EEZ seaward to a maximum of 350 Nm if the continental shelf stretching out from the country reaches beyond the 200-Nm limit. UNCLOS defines the continental shelf as the natural prolongation of the land of a particular country that is submerged but not part of the ocean basin.

The "Akademik Fyodorov," a Russian scientific diesel-electric research vessel, the flagship of the Russian polar research fleet. (Source: Wikipedia)

The treaty also established the Commission on the Limits of the Continental Shelf (CLCS) to examine states' claims, making geologists lead players in debates over ocean jurisdiction.

When UNCLOS came into force in 1994 after Guyana became the 60th country to ratify (currently 162 nations and the European Community, but not the United States, have ratified), only the A-5 countries had claims in the Arctic Ocean under the treaty. The North Pole itself and a great deal of the area around it were initially left unclaimed, an international zone.

After ratifying in 1997, the Russian government and scientific community submitted a petition to the CLCS in 2001 that proposed a massive increase in Russia's claim.

The report asserted that the underwater, 1,800 km Lomonosov Ridge was part of Russia's continental shelf, an extension of the Siberian shelf, and that Russia's claimable limits should be delineated from this geographic formation.

The CLCS neither accepted nor denied the Russian claim but asked for further research and a revised resubmission: a request that prompted the 2007 expedition that dropped the flag, among many others over the past few years. Russia is expected to resubmit in 2012.

The debate over just what defines a continental shelf geologically has huge ramifications. If the Russian claim ultimately succeeds, it would result in the accession of more than 1.2 million square kilometers to Russian Arctic sovereignty. Or, as the Oxford Institute noted in 2007, "If Moscow is successful in its bid for more Arctic territories, its hydrocarbon share could increase by at least 10 billion tonnes (74 BOE) or two-thirds of the global annual energy consumption."

The Russian 2007 expedition found, perhaps not unexpectedly, "that the crust structure of the Lomonosov Ridge corresponds to the world analogues of the continental crust, and it is therefore part of the Russian Federation's adjacent continental shelf."

The Russian claim is but the first of many coming out of the A-5 countries. Each country has a decade after ratification to submit claims for revised delimitation of sovereignty.

However, there is an increasing rush to get the claims in for fear that the early bird will get the worm. The Russians had hoped that by submitting early, the boundaries of their EEZ might have been settled before anyone else thought to get in the race. The fact that the United States still has not ratified UNCLOS has left them out of any debates and deliberations.

Both Canada and Denmark, which have until 2013 and 2014 respectively to submit their petitions to CLCS, claim that the Lomonosov ridge is in fact an extension of their continental shelves, and they have sent their own teams of scientists to gather proof. Canada has also indicated that it will assert that the Alpha ridge is part of their continental shelf off Ellsmere Island. In 2006, Norway too handed in an official submission for reconfiguration of its Arctic Ocean sovereignty.

At the same time, there are other contestations among other A-5 countries. Canada and Denmark continue to spar politely over which controls tiny, uninhabited Hans Island. The U.S. and Canada remain locked in a debate whether the Northwest Passage represents Canada's internal waters or an international strait.

Since the early 1970s, the U.S. has flouted Canadian sovereignty claims to these waters by sending through its vessels (especially submerged nuclear submarines during the Cold War). Now, the question also revolves around shipping and who might have greater control of the Beaufort Sea and its potential hydrocarbon riches.

The CLCS is not likely to resolve these issues any time soon, considering its backlog of submissions and the appeals and arbitration that will surely follow.

Cooperation or Conflict in the Arctic Future

For all of the potential international tensions of this race for the Arctic—and the chest beating surrounding the 2007 flag planting at the North Pole—cooperation seems a more likely future path for the A-5 in the delimitation of sovereignty in the Arctic.

Given the potential for all A-5 countries to profit from the changing Arctic and the very significant difficulties and vast expense of resource extraction and shipping, there is incentive to work together to the mutual profit of all.

As the International Institute for Strategic Studies noted in a 2012 report: "a growing military and paramilitary presence in the Arctic may be beneficial for regional stability rather than detrimental. This is because the various littoral countries already share strategic goals in the High North: to expand trade, protect the environment, extract resources and police new sea areas."

Russia' ambassador for Arctic Affairs, Anton Vasiliev, pushes the cooperation approach. In a recent comment, he played off the forbidding climate, saying, "You cannot survive alone in the Arctic: this is perhaps true for countries as well as individuals."

So far, all parties have been willing to work through existing transnational legal structures and organizations. They are content to follow the rules of the UNCLOS treaty, and are not acting unilaterally. The Arctic Council's first binding agreement was a multinational search and rescue protocol.

Notably, the possibility of great riches has offered incentive for countries to work out their differences. In 2010, after forty years of quarreling, Norway and Russia agreed to a new border in the Barents Sea that will facilitate oil and gas work for both countries.

In April, 2012, Russia's Rosneft completed terms with ExxonMobil to invest as much as $500 billion in developing offshore reserves in Russian Arctic sea areas. Russia recently granted permission for the first shipment of liquefied natural gas from Norway to travel across the NSR.

Each country has different skills and resources to share: Russia, for example, will benefit from access to Norwegian oil companies' state-of-the-art deep-water drilling technologies, while Norway

will rely on Russia for access to the NSR to transport its hydrocarbons east.

Several countries are working together in bilateral research expeditions to explore the geological structures of the ocean floor. Even the 2007 MIR descent to the seabed with its Russian flag had American, Australian, and Swedish backing, organization, and participants.

Moreover, all the A-5 countries have a vested interest in maintaining the cooperative terms of UNCLOS to ensure that no other countries can push their way into the potential Arctic bonanza.

The hubbub following the Russian flag planting led to the Ilulissat Declaration (2008), named for the town in Greenland where representatives of the A-5 met. One of the chief goals of the meeting was to ensure "the orderly settlement of any possible overlapping claims" and that no other countries try to change the rules of the game.

The European Union, certain African countries, and others have argued that the Arctic is a unique situation and should not be governed by UNCLOS; that the ocean should be protected under international ownership because of the rich and generally pristine waters.

In response, the host of the Ilulissat conference, Per Stig Møller, challenged "the assumption by some that there is a need for a new legal regime for the Arctic Ocean. I do not see such a need, as we have international law, we have the Law of the Sea, which already provide us with a comprehensive legal regime."

In the end, cooperation or not, it bears noting that in this "race for the Arctic" few leaders, analysts, and investors are thinking much about the primary stakeholders in the Arctic world: the indigenous peoples who have inhabited the Arctic region for generations and the native fauna and flora. The destruction of the habitats and cultures of these people and other living creatures would be a high price to pay for whatever hydrocarbons and northern shipping the warming Arctic might offer. ◆

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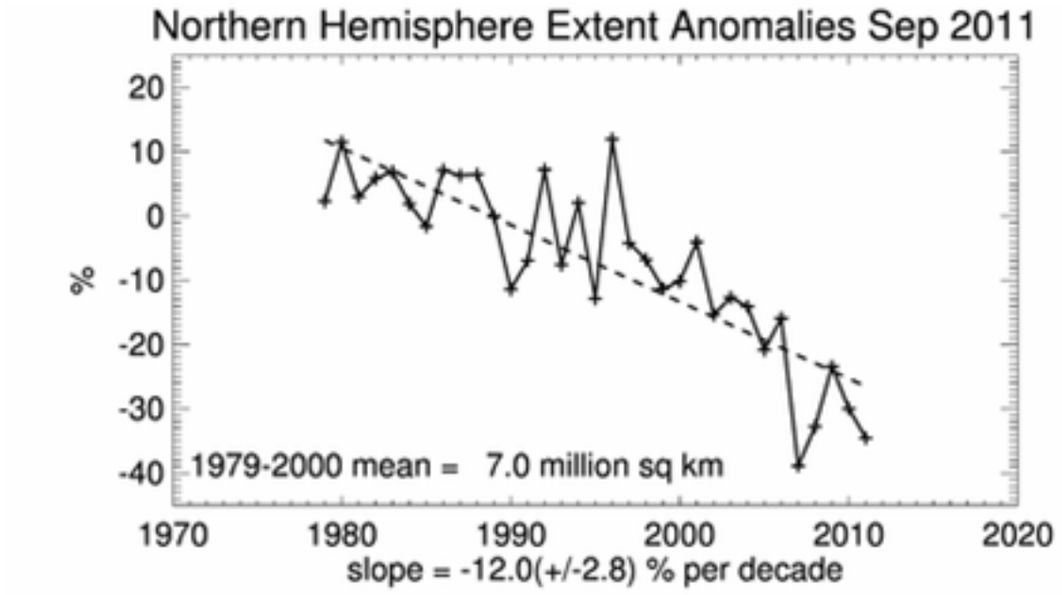
Maps and Charts

The sea ice area for the Arctic shows near-record minimums since 2002



(Source: National Oceanic and Atmospheric Administration)

The Northern Sea Route (blue) as compared to a southern route (red), showing the tremendous savings in travel distance

(Source: Wikipedia)

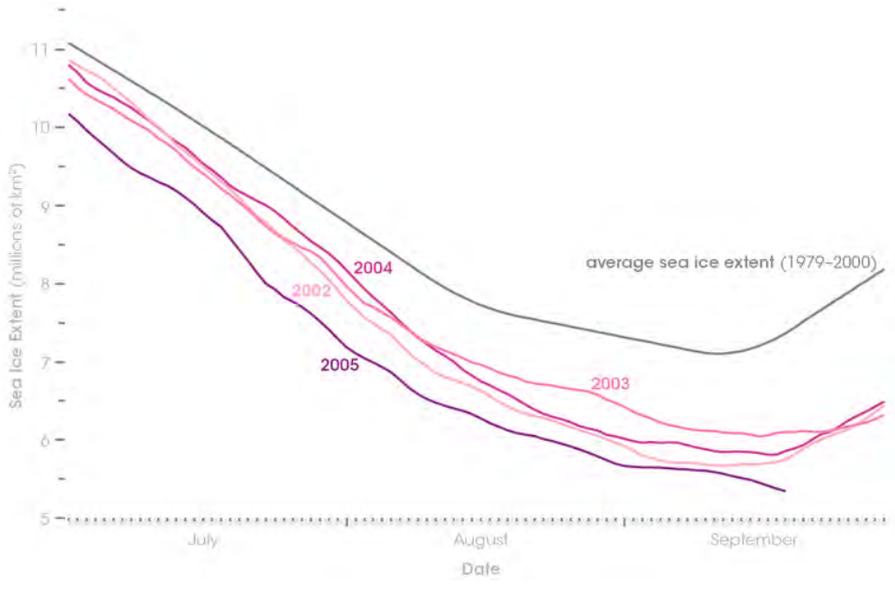
The claimable Arctic Ocean territory for each of the A-5 countries according to UNCLOS, before additional continental shelf claims.

Note the waters around the North Pole are international. The darker blue area represents the waters Russia has petitioned for based on claims that the Lomonosov ridge is part of its continental shelf.

The East Siberian Sea, part of the Arctic Ocean

(Source: Wikimedia Commons)

The decline of Arctic sea ice over the summer months from 2002-05 as compared to 1979-2000



(Source: Robert Simmon, NASA Earth Observatory, and Walt Meier, NSIDC)

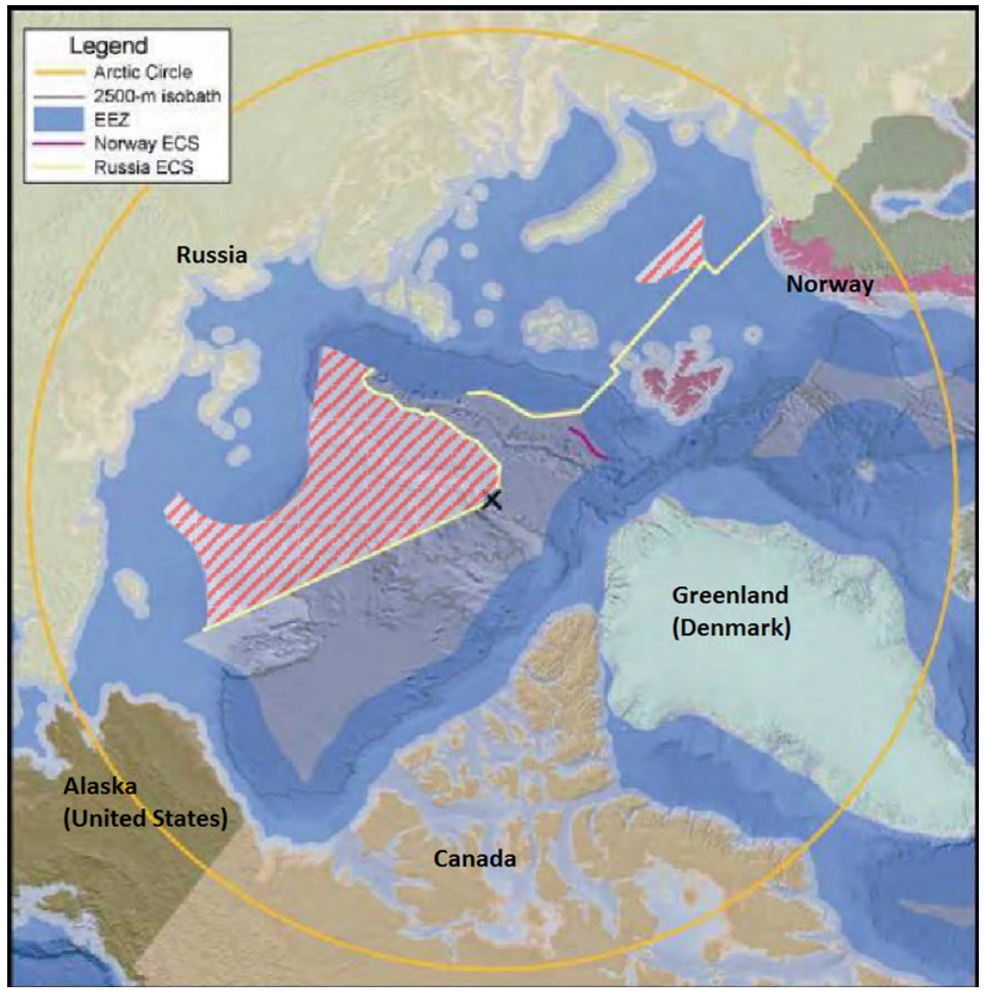
The Great Northern Expedition of the 1730s and 1740s followed the Arctic coastline and proved the existence of a Northeast Passage.

(Source: Wikipedia)

The Kara Sea, north of Russia and south of the Arctic Ocean

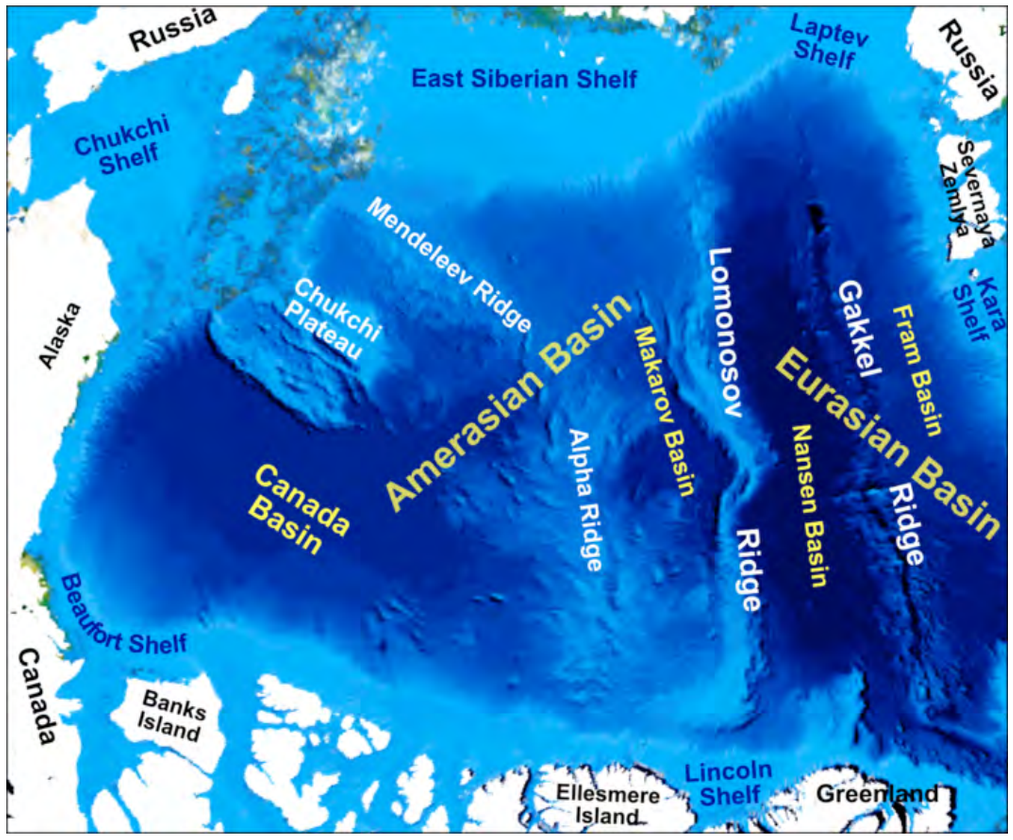
(Source: Wikipedia)

The hashed area shows Russia's current claims in the Arctic Ocean.



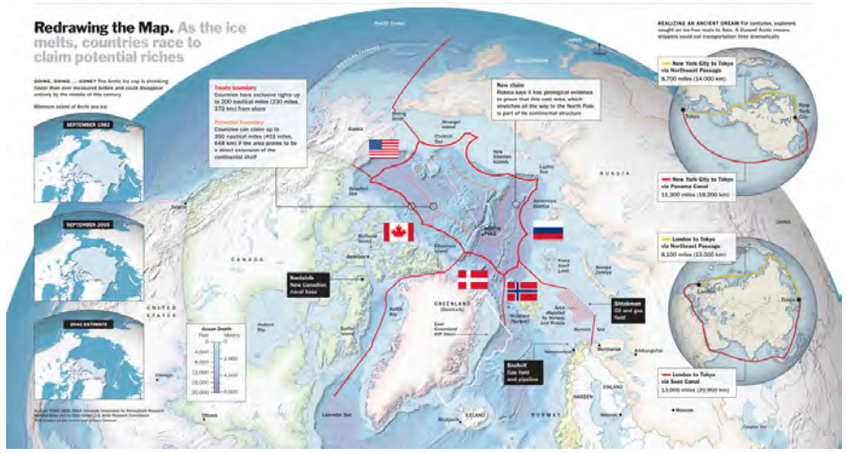
(Source: Wikipedia)

Main Bathymetric features of the Arctic Ocean

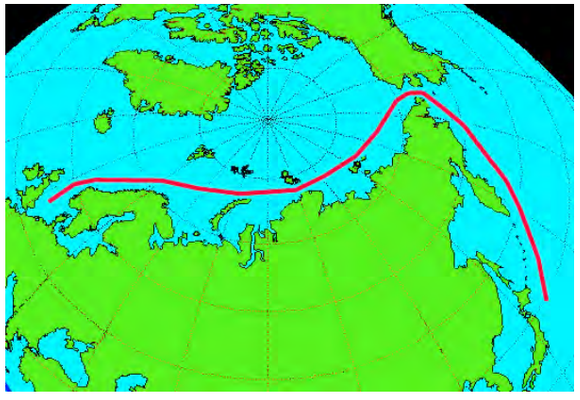


(Source: Wikipedia)

Melting sea ice means access to ocean-floor resources and improved shipping routes, causing a "race for the Arctic."

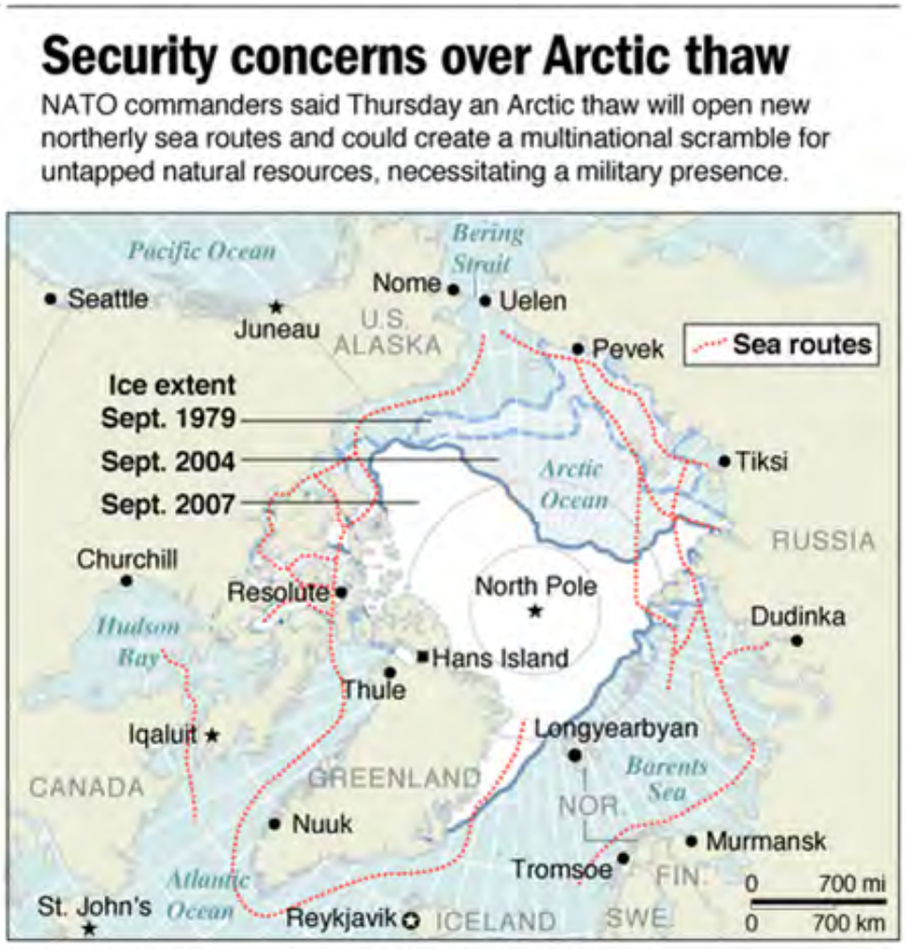


The Northern Sea Route



(Source: Wikipedia)

New sea routes could be established as the Arctic ice melts.



SOURCES: NOAA, National Snow and Ice Data Center; University of Alaska-Fairbanks, International Arctic Research Center

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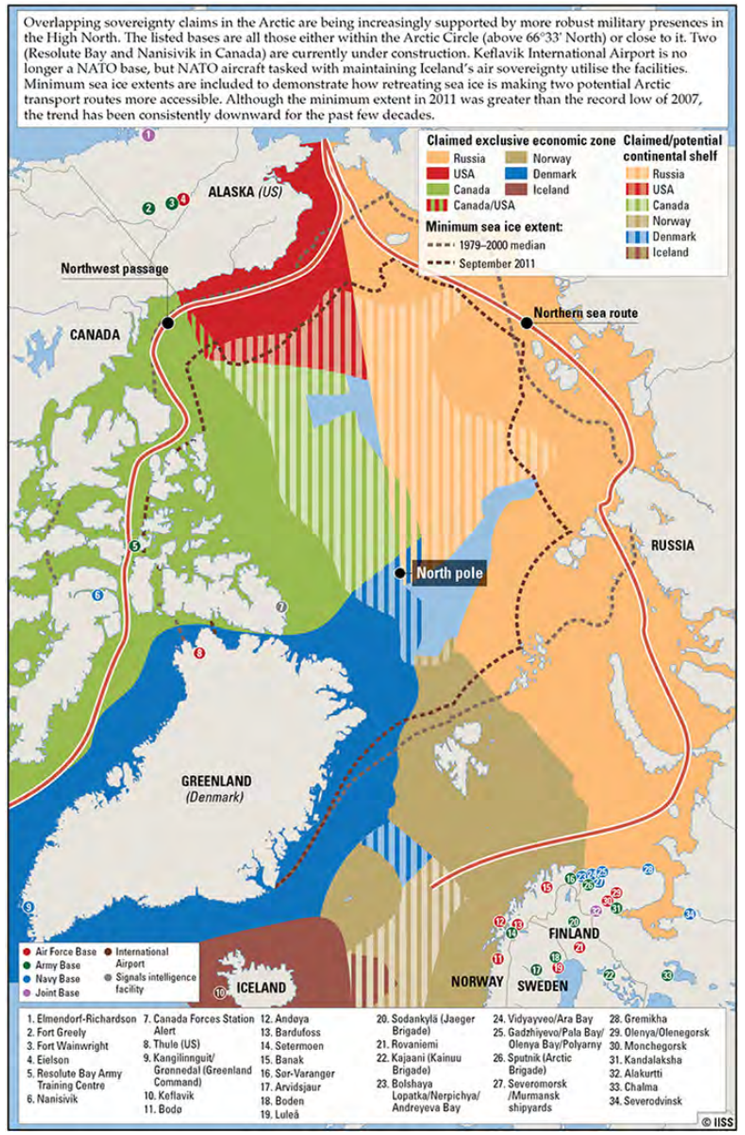
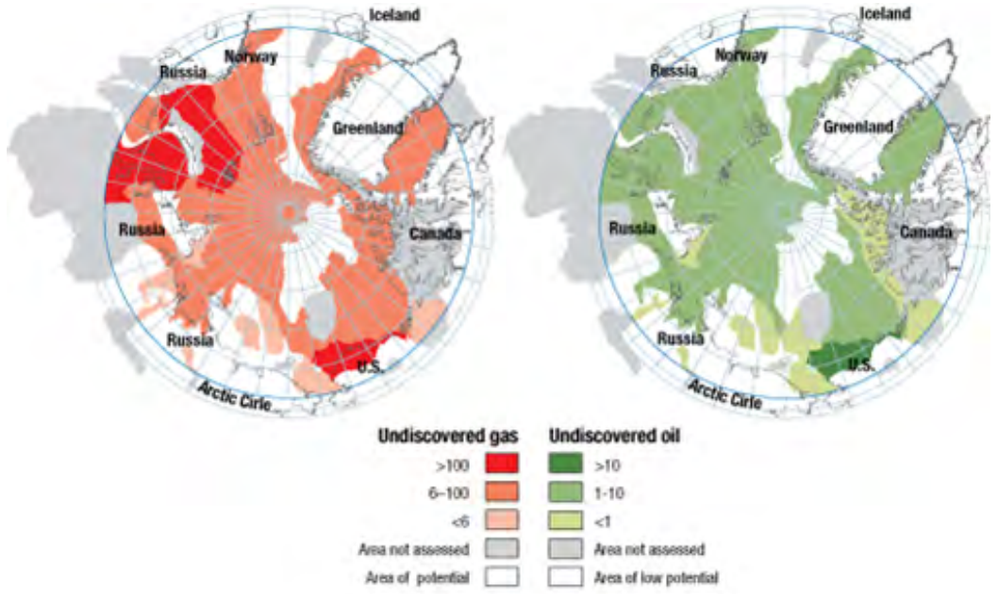
Overlapping sovereignty claims in the Arctic have resulted in increased military presences there.



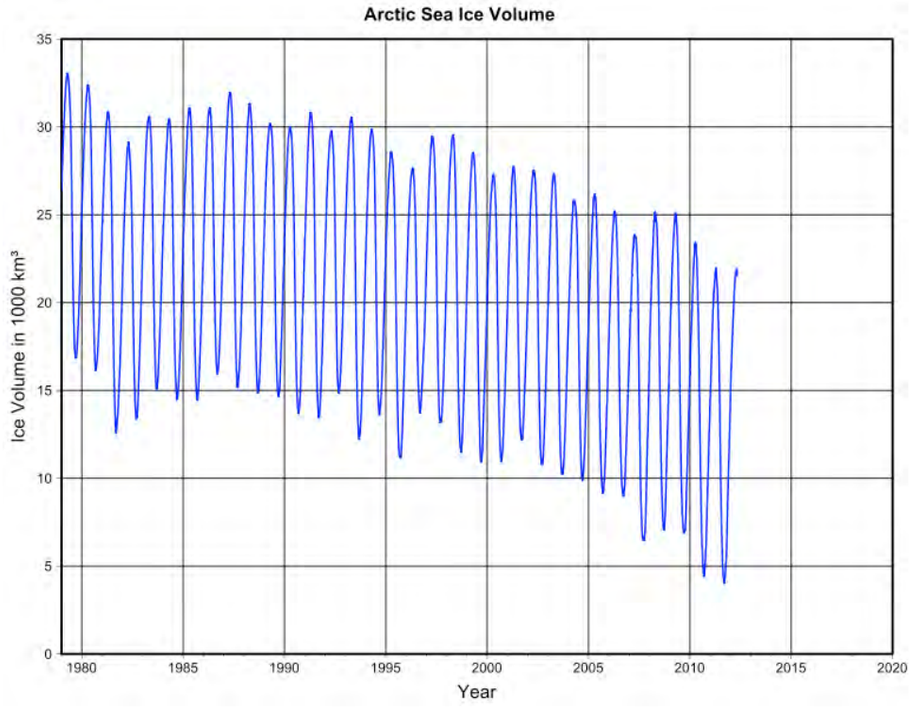
Potential oil (orange) and gas (green) resources in the Arctic



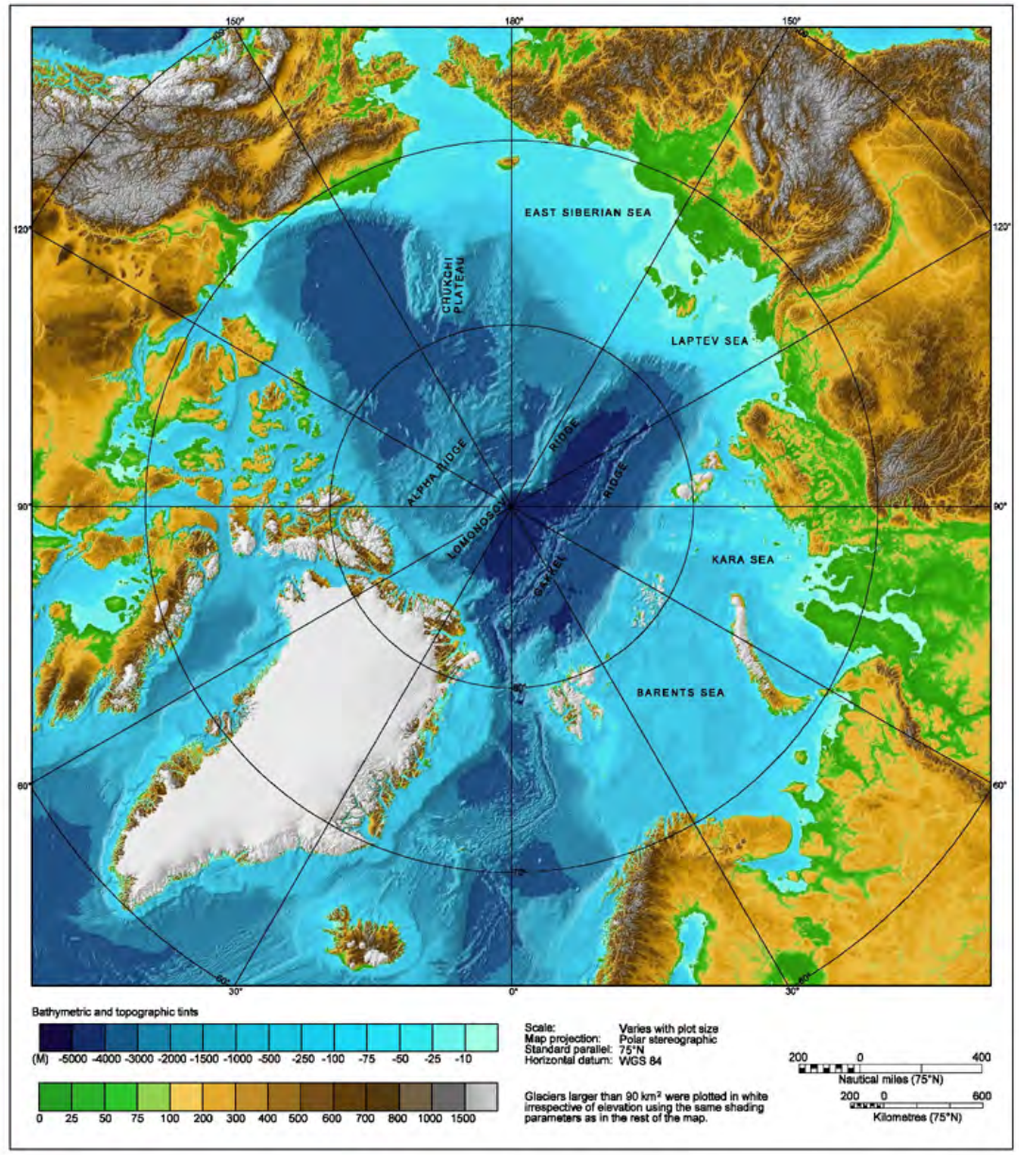
The Arctic Circle

(Source: CIA World Fact Book)

Arctic sea ice by volume over time

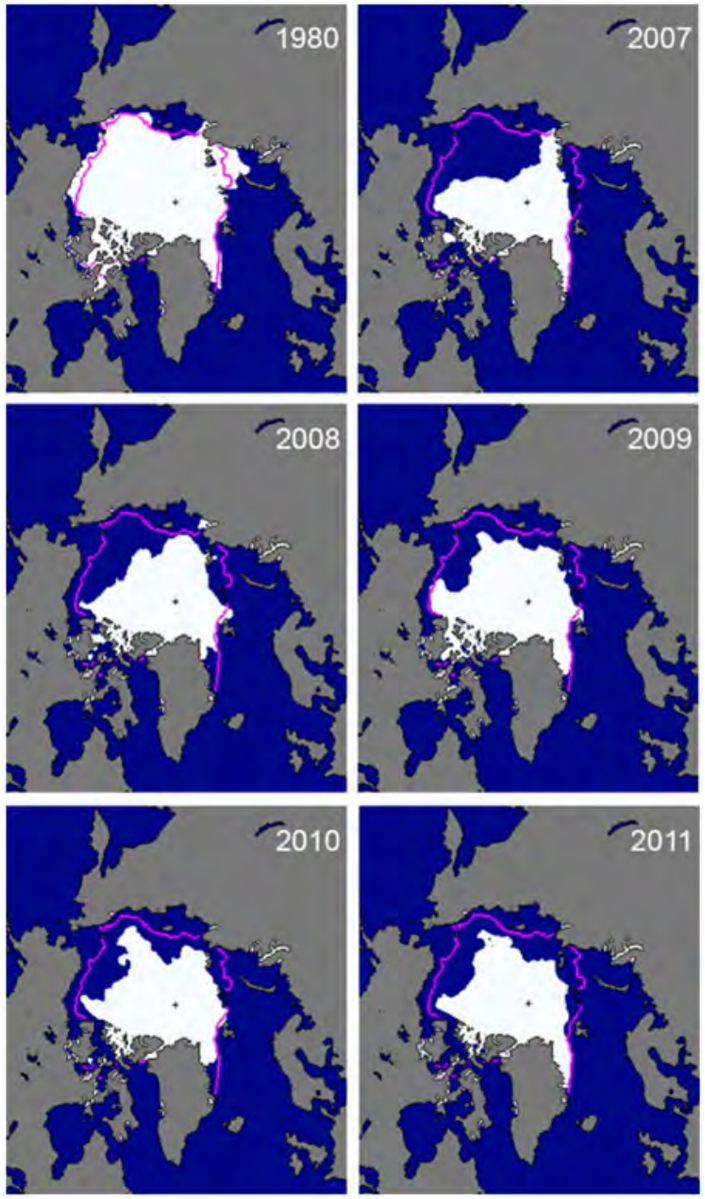


Bathymetric (underwater depth) map of the Arctic Ocean, showing the Lomonosov, Gakkel and Alpha ridges



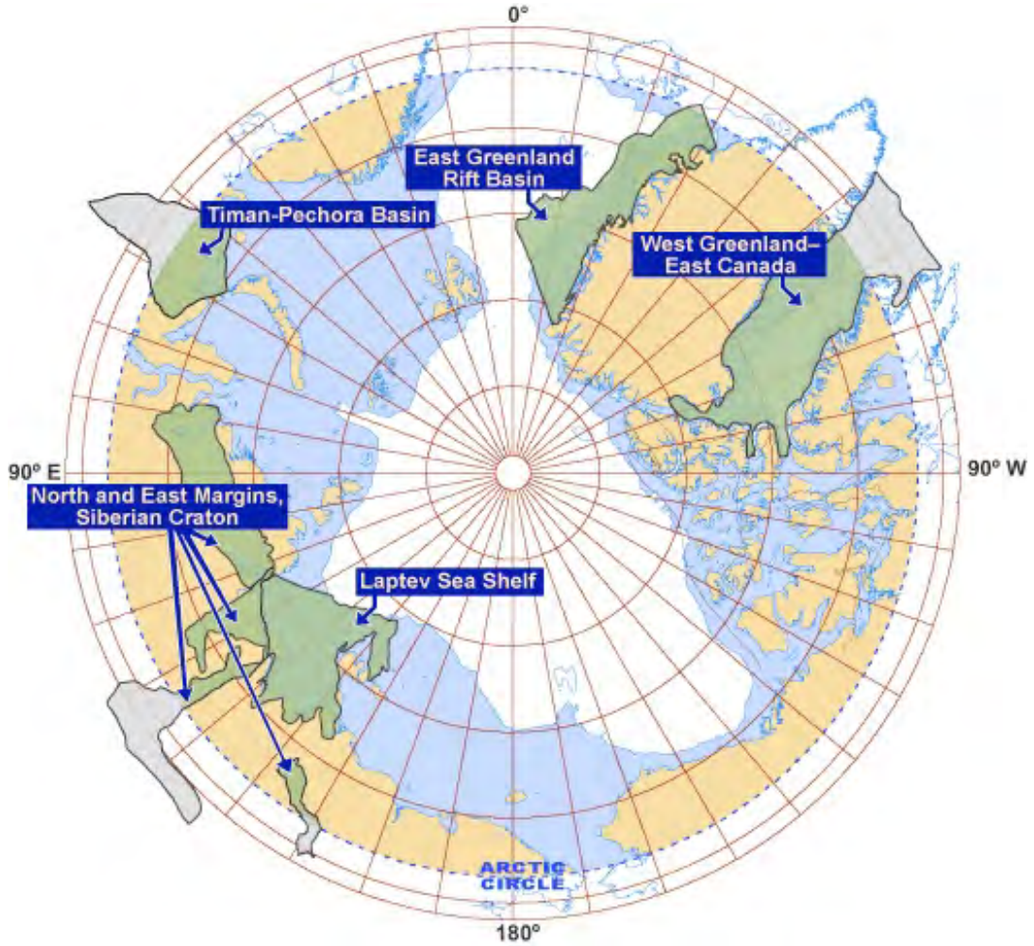
(Source: National Oceanic and Atmospheric Administration)

Decreasing extent of summer sea ice in the Arctic



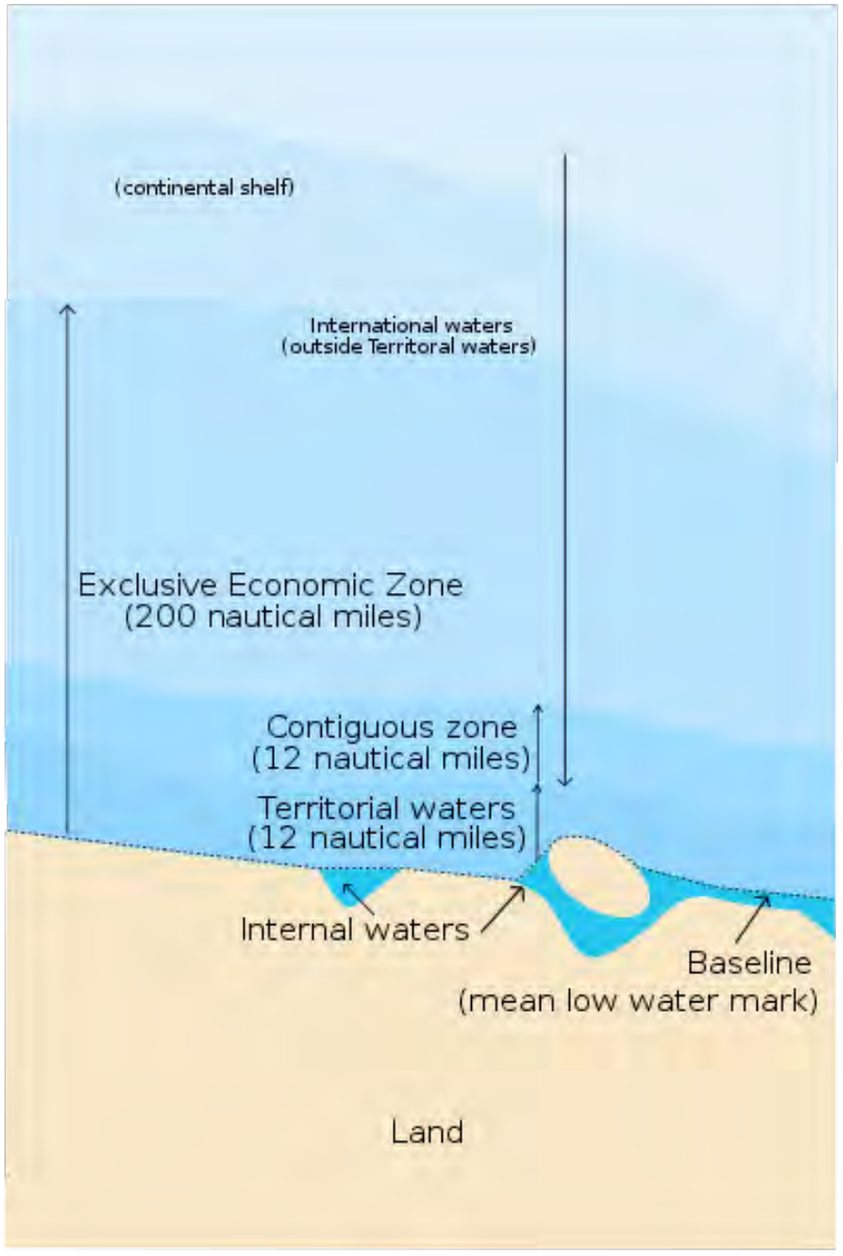
(Source: National Oceanic and Atmospheric Administration)

Estimates of undiscovered oil and gas north of the Arctic Circle



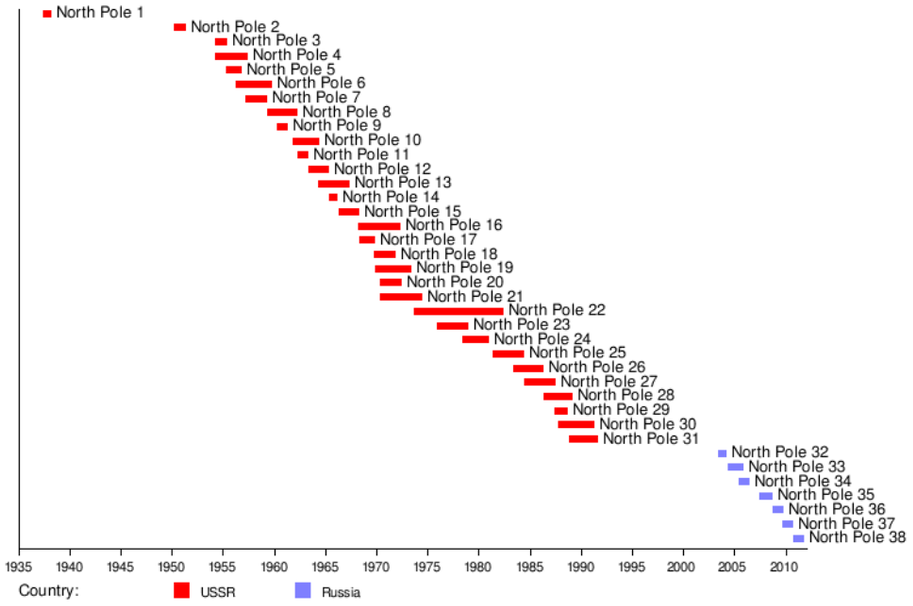
(Source: U.S. Geological Survey)

International rights and claimable sovereignty in sea areas according to the 1982 UN Law of the Sea Treaty



(Source: Wikimedia Commons)

Chart showing the dates of the Soviet and Russian Arctic drift research stations



(Source: Wikipedia)

Additional Images

"North Pole 36" personnel pose in front of a nuclear-powered icebreaking ship.

(Source: Wikipedia)

Arctic ice melting in September 2009

(Source: US Geological Survey)

At a press conference, Artur Chilingarov holds a photo of the Russian flag his exploration team planted underwater at the North Pole.

(Source: Wikipedia)

Canadian HMCS Goose Bay moored at the future site of the Nanisivik Naval Facility, during Operation Nanook, in August 2010

(Source: Wikipedia)

Envelope commemorating 50 years since the historic 1937 flight of M. M. Gromov from Moscow to San Jacinto over the North Pole

(Source: Wikipedia)

Front view of the MIR submersible as it is hoisted into the water

(Source: Wikipedia)

Russian coin commemorating the 1937 North Pole-1 research station

(Source: Wikipedia)

Russian nuclear-powered icebreaker "Yamal"

(Source: Wikipedia)

The "Akademik Fyodorov," a Russian scientific diesel-electric research vessel, the flagship of the Russian polar research fleet

(Source: Wikipedia)

The aerial rescue of the "Cheliuskin" research team is a proud Russian memory.

(Source: Wikipedia)

The Russian flag is lowered in August 2009 at the conclusion of work at the "North Pole 36" research station.

(Source: Wikipedia Commons)

Russia commemorated Arctic explorer Otto Shmidt on this postage stamp.

(Source: Wikipedia)

Statue in Nizhnii Novgorod celebrating the Arctic pilot V. P. Chkalov. The pedestal displays the route of his historic 1937 flight from Moscow to Vancouver, WA via the North Pole.

(Source: liveinternet.ru)

Station Commander of North Pole-1, Ivan Papanin

(Source: Wikipedia)

Section 3

‘The World’s Worst Humanitarian Crisis’: Understanding the Darfur Conflict

EDITOR’S NOTE:

Since 2003, the Darfur region of western Sudan has been the site of terrible violence, death, and displacement; what the United States has labeled 'genocide.' Despite what is currently the world's largest relief operation, efforts to calm the conflict and assist the approximately five million Darfurians suffering ongoing deprivation have produced precious few results. With no end in sight for the turmoil, Ahmad Sikainga, a native of Sudan and Professor of History at the Ohio State University, explores the origins and current status of the Darfur conflict.

This article is part of a larger research project, which was supported by grants from the Ohio State University's Mershon Center and Kirwan Institute for the Study of Race and Ethnicity. The author and Origins are grateful to both centers.

Published February 2009.

For more on current events in Africa, please see Claire Robertson's article on violence in Kenya.

By AHMAD SIKAINGA

For the past four years, the remote Sudanese region of Darfur has been the scene of a bloody conflict that has led to the death of thousands of people and the displacement of more than two million. The United Nations has described it as "the world's worst humanitarian crisis" and the United States government called it "genocide." The violence and destruction is often compared to the 1994 genocide in Rwanda.[1]

A refugee camp holding thousands of displaced Darfurians/Sudanese in the aftermath of war in the western part of Sudan. A long history of civil war, local tensions, government distrust, and new environmental pressures have scarred the country and brought about "the world's worst humanitarian crisis." (Source: USAID)

These tragic events have riveted the international community and attracted unprecedented media attention. However, much of the media coverage tends to follow the familiar patterns of sensationalizing the story rather than providing a nuanced analysis of the root causes.

The Darfur tragedy has often been reduced to pictures of miserable refugees living in squalid conditions and caricatured accounts of "Arabs" killing "Black African Muslims." Moreover, much of the coverage tends to perpetuate the old (and easy) stereotypes about Africa as a continent that is uniquely afflicted by civil wars and instability.

Behind the tragic events in Darfur lies a complex history of deeply entrenched social inequalities, an environmental crisis and competition over natural resources, conflicting notions of identity, the militarization of rural societies, and, above all, a chronic problem of bad governance that has plagued the Sudan since its independence from British colonial rule in 1956.

Sudan's Nuba Mountains. (Source: USAID)

Darfur: A Profile

The Darfur region lies in the western part of the Sudan (Africa's largest country), near the borders with Libya, Chad, and Central African Republic. The population of Darfur was estimated in 2002 at about six million, eighty percent of whom live in the rural areas.

The Flag of Sudan. (Source: Wikimedia Commons)

At the outset, it is important to dispel a number of misconceptions that have characterized the media coverage of the Darfur conflict. Labeling it as one between "Arabs" and "Black Africans" is misleading. In reality, there are no visible racial or religious differences between the warring parties in Darfur. All parties involved in the conflict–whether they are referred to as "Arab" or "African"–are equally indigenous, equally black, and equally Muslim.

Darfurians represent a multitude of ethnic and linguistic groups. They include non-Arabic speaking groups such as the Fur, Masalit, Zaghawa, Tunjur, and Daju as well as Arabic-speaking such as Rizaiqat, Missairiyya, Ta`isha, Beni Helba, and Mahamid, just to name a few (see map). There are also a large number of West Africans, such as Hausa, Fulani, and Borno. These diverse

groups are dispersed among each other and share similar physical and cultural characteristics.

A long history of internal migration, mixing, and intermarriage in Darfur have created remarkable ethnic fluidity: ethnic labels are often used only as a matter of convenience. For instance, in the Darfur context, for the most part the term "Arab" is used as an occupational rather than an ethnic label, for the majority of the Arabic speaking groups are pastoralists. On the other hand, most of the non-Arab groups are sedentary farmers. However, even these occupational boundaries are often crossed.

For several centuries, the Fur were the dominant political power in the region, particularly in the pre-colonial era. In the seventeenth century they established a kingdom that shared many of the characteristics of other Muslim states in the Sahelian belt. (The Sahel or the Sudanic belt refers to the region south of the Sahara Desert, stretching from the Atlantic Ocean in the west to the Nile basin in the east.) From its capital at Al-Fasher, the Darfur kingdom established extensive political and commercial links with these states as well as with Egypt and North Africa.

The Fur kingdom remained the leading regional power until it was destroyed in 1874 by the forces of Al-Zubair Rahmad, the northern Sudanese trader and adventurer, who brought it under the Turco-Egyptian colonial administration (1820-1884).

Turco-Egyptian rule was overthrown in 1884 by an Islamic revivalist movement —known as the Mahdiyya— led by Muhammad Ahmad ibn Abdalla, who claimed to be the Mahdi or the guided one. Many Darfurians supported the Mahdiyya and were among its most loyal followers. In fact, the Khalifa `Abdullahi, successor of the Mahdi, was a native of Darfur.

al-Mahdi leader Muhammad Ahmad al-Mahdi. Sketch from 1880s. (Source: Wikipedia)

The Mahdist state ruled the Sudan until 1898 when it was conquered by the Anglo-Egyptian armies. Following the establishment of an Anglo-Egyptian regime, the kingdom of Darfur was revived by Ali Dinar, a descendant of the royal lineage of the earlier kingdom, and a general in the Mahdist army.

The Sultanate of Darfur remained independent until World War I. However, as a consequence of Ali Dinar's links with the Ottoman Empire during the war, the British invaded and annexed Darfur into the Anglo-Egyptian domain in 1916.

Since its independence in 1956, Sudan has been bedeviled by a succession of civil wars and political instability. The Darfur conflict

should be seen as part of these larger, ongoing series of Sudanese crises, with one conflict spilling from one part of the country to another. The first and the most notorious of these struggles was the North–South conflict, which ended with the signing of the peace agreement in 2005 (after two rounds of fighting, 1955-1972 and 1983-2005). Regional conflicts also occurred in the Nuba Mountains, the Upper Blue Nile, and the Beja region in the eastern parts of the country.

These conflicts can be attributed to the deeply rooted regional, political, and economic inequalities that have persisted throughout Sudan's colonial and post-colonial history. These inequalities are exemplified by the political, economic, and cultural hegemony of a small group of Arabic-speaking Sudanese elites who have held power and systematically marginalized the non-Arab and non-Muslim groups in the country's peripheries.

Prelude to Conflict: The Environment

The current Darfur conflict is a product of an explosive combination of environmental, political, and economic factors. It is well known that environmental degradation and competition over shrinking resources have played, and continue to play, a critical role in communal conflicts in the Sahelian countries such as Mali, Niger, and Chad. In this regard, Darfur is no exception.

The Darfur region consists of a number of climatic zones. The southern part lies within the rich savanna, which receives considerable rainfall. The central part is a plateau where the mountain of Jebel Marra dominates the landscape. The northern part of Darfur is a desert that extends all the way to the Egyptian and Libyan borders.

Crop farming is the main economic activity of the majority of the population. Cultivation depends heavily on rainfall and land fertility, rendering the population vulnerable to climatic changes and natural disasters. Particularly in the 1980s and 1990s, drought, desertification, and population growth combined to produce a sharp decline in food production and with it widespread famine.

Inner and outer crater, Deriba Crater, Jebel Marra, Darfur, Sudan. (Source: Wikipedia)

Also at the heart of the competition over resources is the question of land ownership. The land tenure system in Darfur has evolved over several centuries, producing a current hybrid set of practices that have tended to increase inter-communal tensions. Under the Fur kingdom, land ownership was based on the *Hakura* system. The term came from Arabic *Hikr*, meaning ownership.

According to this system, each group was given a Hakura, or *Dar,* which is regarded as the property of the whole community. The local chief was the custodian of the Dar and was responsible for its allocation to members of his group for cultivation. The Dar was revered by the people of Darfur. Belonging to a Dar became an integral part of the person's identity. At the same time, successive rulers of Darfur allocated land to specific individuals—such as high-ranking officials of the kingdom—for personal ownership.

Under British colonial rule, the land tenure system was modified to suit the system of indirect rule or what was called native administration. As in other parts of Africa, colonial officials in Darfur found it convenient to assume that local chiefs had defined authority over ethnic groups and jurisdiction over corresponding territory. Hence, the application of native administration involved the assignment to each group of specific territories. Local chiefs were then given the authority to allocate land to residents.

Both the system of land tenure and native administration underwent major changes during the post-colonial period. Post-independence Sudanese rulers regarded native administration as

Commemorative English Poster of the War in Sudan-1897. (Source: Library of Congress)

an archaic system that was part of the colonial legacy and gradually dismantled it.

Most importantly, these policies led to the erosion of the chiefs' authority. In turn, the changes to the land system diminished their ability to settle inter-communal disputes.

Pastoralists and Sedentaries

Conflict between pastoralists and sedentary farmers, caused in part by environmental pressures and changing land ownership patterns, was an important cause of the Darfur violence.

Pastoral nomadism is the main means of livelihood for many Darfurians. One of the most prominent cattle-herding groups in this region is the Arabic-speaking Baqqara, who are scattered between Kordofan and Darfur provinces. The Baqqara consist of several ethnic groups such as the Ta`isha, Rizaiqat, Beni Helba, Misairiyya, and others.

The desert region of northern Darfur is inhabited by camel-owning nomads who were known locally as *abbala* (camel owners). The nomads were not part of the hakura system. Hence, the nomads had to rely on customary rights to migrate and pasture their animals in areas dominated by farmers. As the nomads moved between the northern and the southern part of the region, specific arrangements for animal routes were made by their leaders and those of the farming communities, and these arrangements were sanctioned by the government.

The system worked for decades until the drought of the 1980s. As the climate changed, the expected dates of crop harvest became unpredictable, and many farmers began to switch to animal husbandry and needed grazing land.

At the same time, the pastoralists were also feeling the effects of the drought as grazing land in northern Darfur shrank considerably. Faced with this situation, camel nomads insisted on maintaining the traditional arrangements, which became a source of major clashes.

Beja Bedouins in Sudan with Camels. (Source: Wikipedia)

The struggle over diminishing resources in the 1980s led to several clashes between pastoralists and farmers. These sorts of quarrels were by no means new, as they had erupted several times during the colonial and post-colonial periods. For many years, both groups employed a variety of mechanisms to resolve these conflicts. These mechanisms were based on local customs and practices, such as *Judiyya* or mediation, native administration, tribal festivals, intermarriage between different ethnic groups, and exchange of gifts.

One the most important mechanisms for conflict resolution was the tribal conference, which was usually arranged by local chiefs after violent incidents. However, the abolition of the system of

native administration dealt a serious blow to these traditions. Moreover, successive Sudanese rulers in Khartoum began to manipulate these conflicts for their own benefit.

Ethnic Tensions and Porous Borders

Environmental degradation and competition over resources can be understood as principal causes of communal conflict in Darfur, but the ongoing carnage is also a product of a long history of ethnic marginalization and manipulation by Sudan's ruling elites.

Mosque in Khartoum, 1976. (Source: Wikipedia)

The post-colonial governments were dominated by the Arabic-speaking elites from the central and the northern parts of the country. In addition to concentrating economic development in their home regions, these elites tried to forge a national identity based on Arabism and Islam. These policies generated a tenacious resistance by the non-Arab and non-Muslim groups in the marginalized region of the South, the Nuba Mountains, and the Red Sea region.

A number of regionally and ethnically-based rebel movements emerged in the 1950s and the 1960s, particularly in the South where a civil war raged for several decades. In Darfur, an organization called the Darfur Development Front was formed in the mid-1960s to advocate the region's demands for economic development and greater autonomy, but it remained a relatively small movement. Nonetheless, a strong sense of deprivation continued to prevail among Darfurians and continued to shape their relationship with the Khartoum governments.

If internal tensions were not enough, Darfur has also suffered from the instability and conflicts that have plagued its neighbors, particularly Chad and Libya. A number of Darfur ethnic groups such as the Zaghawa, Masalit, and Mahiriyya also live in Chad, which has made it easier for conflicts to spread across borders.

Porous, ethnically intertwined borders affected Darfur during the Chadian civil wars of the 1980s, in which Libya became heavily involved. In addition to mounting a series of military adventures in Chad, Libya supported various Chadian factions who used Darfur as a rear base, pillaging local farmers and cattle-herders and pouring large quantities of arms into the region.

Moreover, Mu`mar Gaddafi of Libya had an ambitious project in the region, which involved the creation of what he called an "Arab Belt" across Sahelian Africa. His goal was to ensure Libya's hegemony in the region.

The scheme involved recruiting and arming discontented Arabic-speaking and Tuareg groups in the Sahel into what came to be

Libya's Muammar Gaddafi with Russian Leader Vladimir Putin, April 2008. (Source: kremlin.ru)

known as the "Islamic Legion" as the spearhead in Libya's offensive in Chad. Some of the legion's members were also drawn from the Arabic-speaking pastoralists in Darfur.

Many of the Sudanese members of the legion were followers of the Madhist sect who engaged in subversive activities against the regime of Ja`far Nimeiri in the 1970s (Nimeiri was President of Sudan 1969-1985). Following their defeat in the aftermath of a failed coup in 1976, remnants of the Mahdists scattered in the border region between Sudan, Chad, and Libya. In the end, Gaddafi's hopes were dashed when the legion forces were defeated by Chadian factions in 1988.

Although the legion was subsequently disbanded, many of its members, well trained and armed, continued to embrace an Arab supremacist ideology. Some of the infamous Janjawid, who are currently committing many of the atrocities in Darfur, were members of the legion. Moreover, a large number of the Mahdists members of the legion had returned to the Sudan after the downfall of Nimeiri's regime in 1985.

In the late 1980s, these returnees formed a political block known as the Arab Alliance and began to disseminate supremacist ideology in the western parts of the Sudan and exhibited great contempt towards the non-Arab groups in the region.

A mounted Janjawid fighter in the Sudan. (Source: Wikipedia, US Government)

Their propaganda involved the claim that the Arabic-speaking groups in the western parts of the Sudan had been politically and economically marginalized, despite the fact that they constitute the majority of the region's population. In addition to land ownership, the alliance called for increased representation of the Arabic-speaking groups in the central government. The attitude of these groups coupled with the policies of the central government has had a profound impact on inter-communal relationships in Darfur.

In tandem with external destabilizing forces from Chad and Libya (among others), the ongoing crisis in Darfur was also the result of events that took place in other parts of the Sudan, particularly the civil war between Southern and Northern Sudan, which resumed in the early 1980s.

The Sudanese People's Liberation Movement (SPLM, and its military wing the Sudanese People's Liberation Army (SPLA)), which led the rebellion in the South, presented itself as the defender of all marginalized groups in the country and raised the slogan of "New Sudan."

Armed Janjawid (in camoflage) in a Sudanese market. (Source: US Government)

The SPLA made relentless efforts to recruit people from the Nuba Mountains, Darfur, the Blue Nile, and the Red Sea regions. Daoud Bolad, a Darfurian who was also a former student activist and member of the Islamicist movement, formed a small pro-SPLA faction in Darfur, but he was subsequently captured and killed by government troops. His 1992 death-by-torture dashed the hopes of the SPLA in Darfur.

Even without his death, however, the religious divide hampered the SPLA efforts in Darfur. While the majority of the SPLA members are Southern Christians, virtually all Darfurians are Muslims who were followers of either the Mahdist movement or the National Islamic Front.

Advent of the Islamicists

Perhaps one of the most important legacies of the SPLM on the political discourse in the Sudan is its call for building a "New Sudan." Embedded in this slogan is the idea of the creation of a secular, plural, and unified Sudan, in which there would be no distinction on the bases of religion, ethnicity, language, gender, and region.

The slogan was perceived as a threat by the dominant Arabic-speaking northern Sudanese elites. One of the most ardent defenders of Arabicism and Islamism as a paradigm of Sudanese identity is the National Islamic Front (NIF), whose main goal was the establishment of an Islamic state in the Sudan and beyond.

Hasan Turabi, the leader and main ideologue of NIF, had an ambitious scheme of spreading the Islamicist ideology in other parts of the Muslim world, particularly in Sahelian Africa. Turabi considered Darfur as the gateway to this region and made considerable efforts to recruit Darfurians into his movement.

Sudan National Islamic Front Leader Hassan al-Turabi. (Source: Fair Use, by The Independent)

From Turabi's perspective, in order to achieve these goals, the NIF had first to seize power in the Sudan. With this goal in mind, the NIF devoted its energies to building a strong economic base as well as expanding its membership among students, professionals, and most importantly, the Sudanese army.

The growing military and political strength of the SPLM in the late 1980s, and the prospects of the SPLA gaining a significant share in power, prompted the NIF to act. Using its considerable financial resources and influence in the army, the NIF staged a military coup in 1989 and overthrew the democratically elected government of Sadiq Al-Mahdi.

Darfur Refugee Camp in Chad. March 2005 (Source: Wikipedia)

Once in power, the NIF embarked on grand scheme of transforming Sudanese state and society in accordance with its ideology. Thousands of people deemed secular were purged from the army, the civil service, and the police, while the regime's opponents were detained, tortured, or killed.

The NIF waged war in the South as "jihad" and pursued it with great vigor. The regime's human rights abuse, its efforts to destabilize neighboring countries, and its policies of harboring militant Islamicists from other parts of the Muslim world led to its international isolation. Western governments imposed sanctions, particularly the U.S. government, which placed Sudan on the list of countries sponsoring terrorism. At the same time, the NIF regime remained extremely unpopular among the Sudanese population as a result of its repression and the severe economic hardships.

In the face of growing isolation, the regime turned to China, which has become its major trading partner and main supplier of arms. The relationship was given further impetus by the production of oil, in which China became the dominant player.

The Peace Agreement with the South

A number of internal and external factors forced both the Sudanese government and the SPLA to enter into peace negotiations in 2003. Prominent among those were the inability of either party to achieve a decisive victory, the economic hardships and growing unpopularity of the Sudanese regime, a split within NIF, and the post-September 11 realities and the Bush Administration's "war on terror."

The peace negotiations were held in Kenya and were sponsored by the Internal Departmental Authority on Development (IGAD), an

East African regional organization, European countries, the UN, and the U.S. government. In 2005 the two parties singed a peace accord that came to be known as the Comprehensive Peace Agreement (CPA).

The CPA was hailed for ending the bloodshed and destruction that were raging in the South for several decades. However, the CPA was also criticized for its focus only on the North-South conflict and for ignoring the grievances of other marginal regions such as Darfur, the East, and other opposition groups. The failure of the Agreement to deal with all of the regional crises and tensions was one of the principal reasons behind the outbreak of the rebellion in Darfur.

In 2003, two rebel movements emerged in Darfur: the Sudan Liberation Army (SLA) and the Justice and Equality Movement (JEM).The leader of JEM is Khalil Ibrahim, who was a former member of the Islamicist movement, which led to speculations that JEM has Islamicist leanings. The SLA, on the other hand, is considered more secular in its orientation. The manifesto of both movements called for greater autonomy for Darfur and redistribution of economic resources and political power.

Violence in Darfur Begins and the World's Response

The spark that ignited the violence in Darfur occurred in April 2003 when the rebels attacked al-Fashir airport and destroyed military equipment and overwhelmed the Sudanese army. The

Internally Displaced Persons (IDPs) use sticks and scraps of plastic to construct makeshift shelters at Intifada transit camp near Nyala in South Darfur. (Source: USAID)

attack took the government by surprise. From the beginning the government dismissed the rebel movement, describing them as nothing more than a band of armed robbers. At first, Khartoum could not mount an effective counter-offensive because its army was overstretched, particularly in the South.

Instead, the government resorted to the sort of unscrupulous tactics of proxy war that it had used in the South and in the Nuba Mountains. This involved the exploitation of ethnic differences and the arming of particular ethnic groups and turning them against others.

The use of this tactic in Darfur was best exemplified by the creation of the infamous Janjawid, most of whom hailed from Arabic-speaking communities (In western Sudanese context, Janjawid refers to rabble or outlaws). In conjunction with the Sudanese army, the Janjawid engaged in a massive campaign of violence and pillaging of non-Arab communities. The carnage resulted in the death of 300,000 Darfurians and the displacement of 2 million.

A protest sign from New York, calling for the end of the Darfur crisis. An example of the increased international attention and outrage against the problems in Sudan. (Source: savedarfur.org)

The scale of destruction outraged the international community and prompted the U.S. government to describe it as "genocide." However, the rhetoric of the international community was not matched by actions.

Both the U.S. and European governments were not willing to intervene militarily and could not develop a coherent policy towards the Sudan. The UN issued a number of threats and passed a series of resolutions. But these were rendered ineffective by the defiance of the Sudanese governments, and the maneuvering of Arab countries and of China, Sudan's main oil-trading partner and supplier of arms.

Member of the military component of the United Nations-African Union Hybrid Mission in Darfur (UNAMID) speaks with one of the villagers during a patrol routine. (Source: United Nations)

The most important bone of contention is the deployment of peacekeepers in Darfur. The Sudanese government declared its objection to the presence of any European troops on its soil and maintained that it would only allow African Union peacekeepers.

As a compromise, the UN passed a resolution in 2007 that provided for the creation of the so-called "hybrid force," or a mixture of UN and African Union troops, to which the Sudan government agreed. However, the deployment of these troops has been hampered by a lack of funds, complicated logistics, and the foot-dragging of the Sudanese government.

Brigadier General Bala Keita (fifth from left), military commander of the United Nations-African Union Hybrid Mission in Darfur (UNAMID), talks with the Arab nomads. (Source: United Nations)

On another level, the UN referred the Darfur case to the International Court of Criminal Justice to investigate accusations of genocide and crimes against humanity committed by the Sudanese government. Although two Sudanese officials were indicted, the Sudanese government vowed not to hand them over.

However, in a dramatic move, the court declared in July 2007 that it is seeking a warrant for the arrest of Omer Al-Bashir, the Sudanese President. A ruling is expected in the near future. It is unclear what will happen if an arrest warrant is issued and how that will affect the situation in Darfur. While some observers think that it may prompt the Sudanese government to suspend all UN operations and thereby worsen the humanitarian situation, others believe that the warrant might actually increase the pressure on the Sudanese government and force it to take the peace process more seriously.

Darfur Peace Process

After a great deal of pressure by the UN, the African Union, and the neighboring countries, the Sudanese government and the Darfur rebels agreed to hold a series of peace talks in Nigeria, which led to the signing of the Darfur Peace Agreement (DPA) in 2006. However, the agreement was signed by only one rebel group and was rejected by the rest who argued that the DPA was a bad deal for Darfur.

The major obstacles to reaching a settlement can be attributed to both the Sudanese government and the Darfur rebels.

Sudanese President Omar Hassan al-Bashir at the United Nations. (Source: Wikipedia)

The Sudanese government is notorious for using agreements as a mere tactic. It is willing to sign any agreement, but determined to find ways to impede or delay its implementation.

Darfur rebels, on the other hand, are highly divided and have no clear vision. It was estimated that there are currently more than a dozen rebel groups who are competing among each other, a situation that has lead to chaotic violence in the region. Efforts to unify the rebels have been hindered by the strategy of the Sudanese government of divide and rule, and by the intervention of foreign governments such as Chad, Libya, and Eritrea.

Most importantly, the Darfur rebels have become part of the proxy war between the Sudanese and the Chadian governments. For instance, in February 2008 the Chadian opposition, with the help of the Sudanese government, tried to overthrow the government of Idris Deby. As a *quid pro quo*, Chad supported the Justice and Equality Movement's daring attack on the Sudanese capital three months later.

The current situation in Darfur does not allow for much optimism. The peace process is frustrated by the foot-dragging of the Sudanese government, the fragmentation of the rebels, and the lack of a strong resolve by the international community. The fate of the Darfur peace process may well be determined by the outcome of the ICC decision on Bashir, the general elections scheduled for 2009, and the deteriorating situation in the border region between northern and southern Sudan. In the meantime, the turmoil continues with no end in sight. ◆

Suggested Reading

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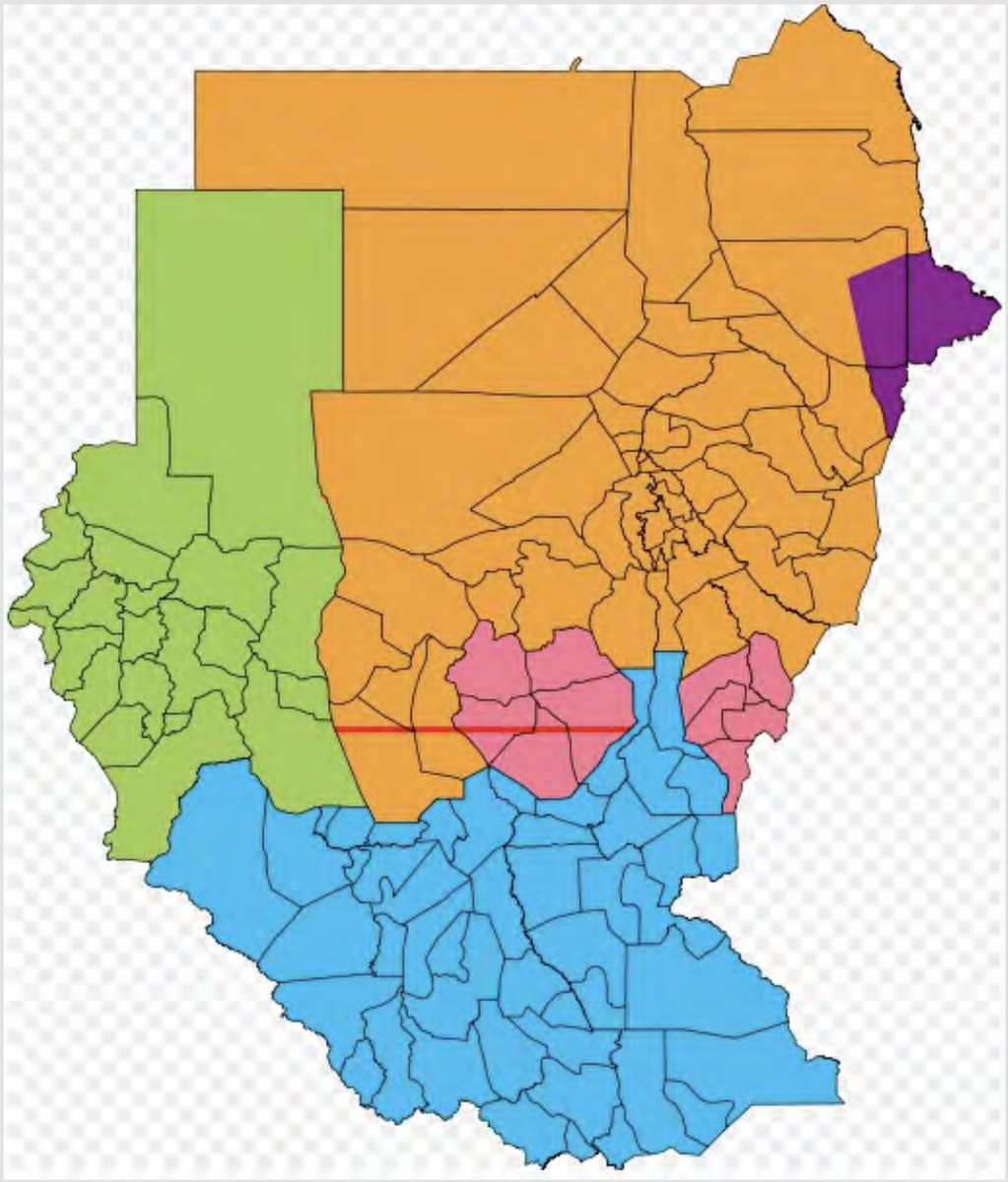
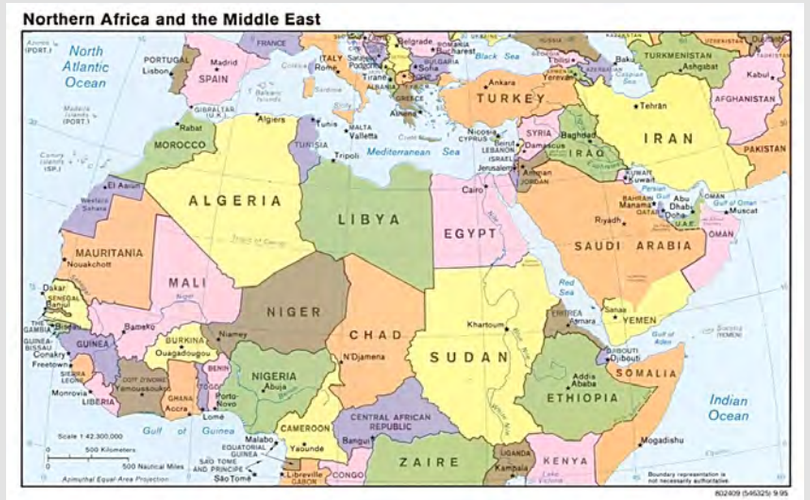
Maps and Charts

Political Regions of Sudan



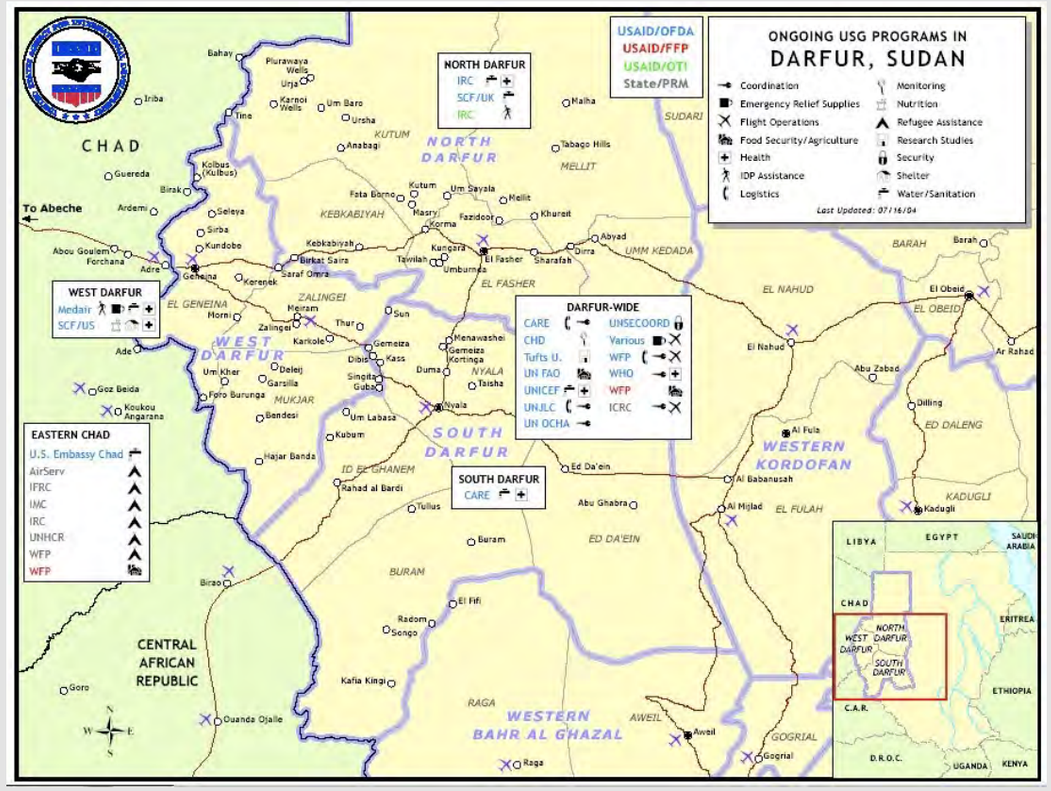
(Source: Wikipedia)

Sudan in its North African and Middle Eastern context



(Source: Perry Castenada Map Library at the University of Texas)

United States Government Aid Programs in Darfur as of 2004



(Source: USAID/Federal Government)

A map showing the strategic and regional responsibilities of members of the UN/African Union Mission in Darfur (UNAMID)

(Source: Open Source-from the United Nations/African Union)

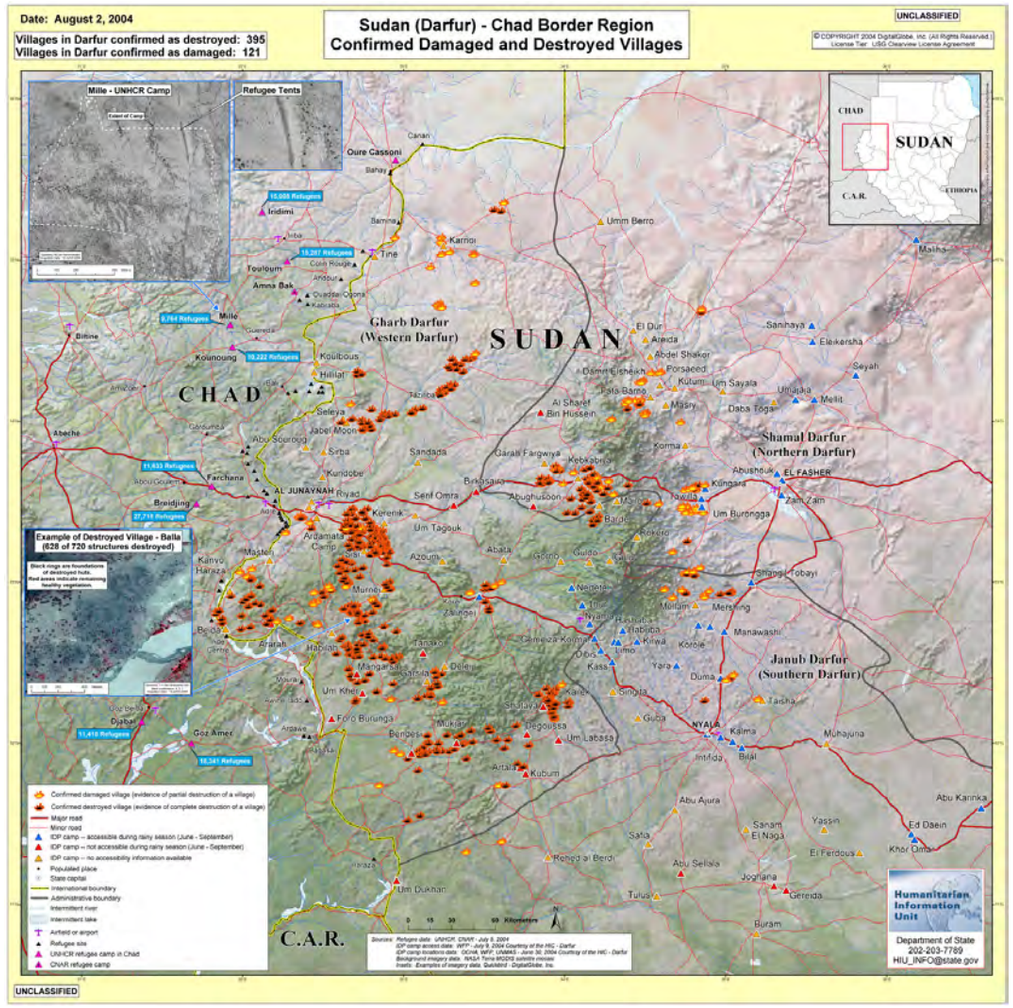
Detailed Political Map of Sudan, 2000

(Source: Perry Castenada Map Library at the University of Texas)

Formatted Satellite Image of Sudan

(Source: Wikipedia)

Map of Darfurian villages destroyed in Sudan as of 2 August 2004

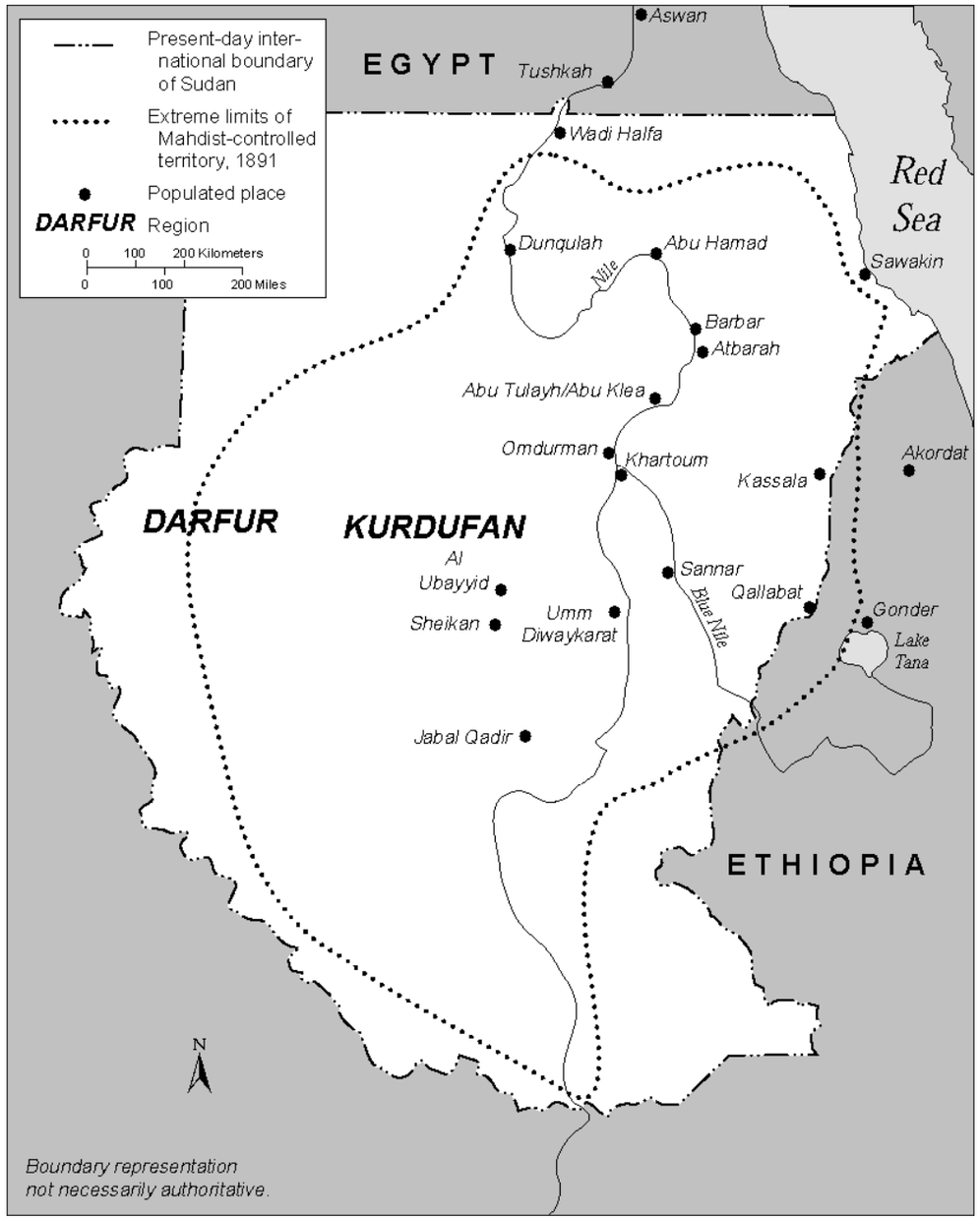


(Source: USAID/Federal Government)

Political map of Darfur in Sudan

(Source: Wikipedia)

Political map showing the outline of the Mahdist State in Sudan at the end of the 19th century



(Source: Federal Government)

Additional Images

Libya's leader, "islamic socialist" Muammar al-Gaddafi

(Source: Wikipedia)

Sudan National Islamic Front Leader Hassan al-Turabi

(Source: Wikipedia)

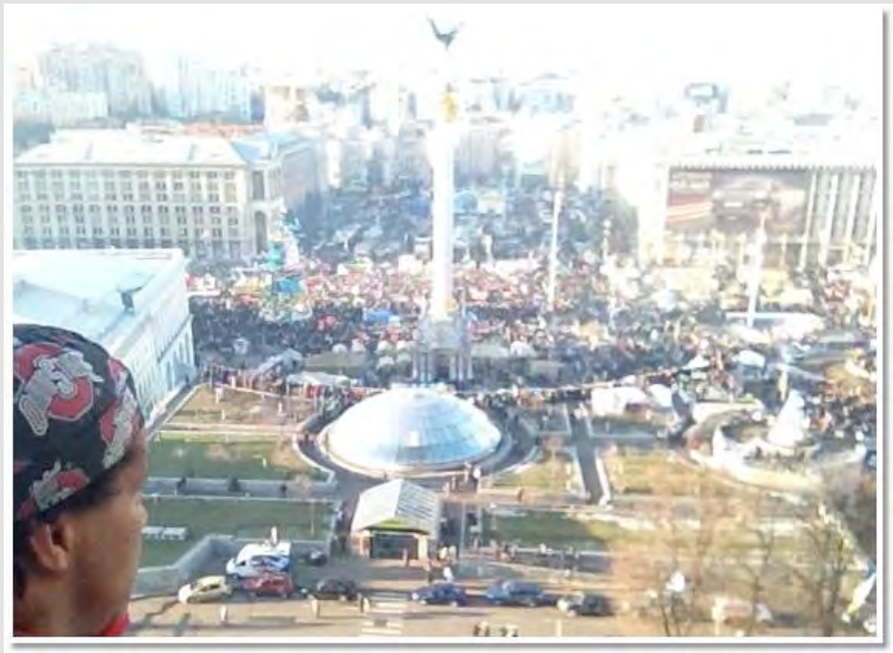
Sudanese President Omar Hassan al-Bashir, speaking in Beijing. 11/3/2006

(Source: Voice of America)

Member of the military component of the United Nations-African Union Hybrid Mission in Darfur (UNAMID) speaks with one of the villagers during a patrol routine

(Source: United Nations and African Union)

Rudy Hightower, of OSU's Glenn School, overlooking Kyiv's Independence Square.



(Source: Rudy Hightower, December 2013)

AU-UN flags are raised jointly to mark the beginning of the joint UN-AU peacekeeping operation. 31 December 2007

(Source: United Nations)

The Coat of Arms of Sudan

(Source: Wikipedia)

Former African Union peacekeepers from Gambia in their new UN blue berets and African Union armbands march at the transition of authority ceremony marking the deployment of the joint AU-UN peacekeeping operation in Darfur-12/31/2007

(Source: United Nations)

Top Ten Origins: Climate Change

By SAM WHITE

There is perhaps no greater challenge facing humanity (and all species on the planet) than climate change. Yet, despite an almost unprecedented scientific consensus on the issue, there remains a vocal and politically connected minority who deny the existence of any meaningful change. Still, the data speaks for itself. Carbon dioxide in the atmosphere, just shy of 400 ppm (parts per million), is at by far the highest level for 650,000 years. Global temperature is up 1.4 degrees since 1880, and glaciers are visibly melting. In February 2015, the Arctic ice cover reached its lowest maximum extent since record keeping began. Ocean temperatures are also rising, as is ocean acidification, and sea levels are up seven inches in the last 100 years. And the list of climate change indicators goes on.

As we celebrate Earth Day, Origins *offers ten essential points to know about climate change on Earth.*

Published April 2015.

(A video version of this Top Ten is available at https://youtu.be/67wV_yu8Z0Q.)

The massive eruptions that formed the Deccan Traps about 66 million years ago altered global climate, possibly contributing to the extinction of many dinosaur species. (Source: Wikimedia Commons)

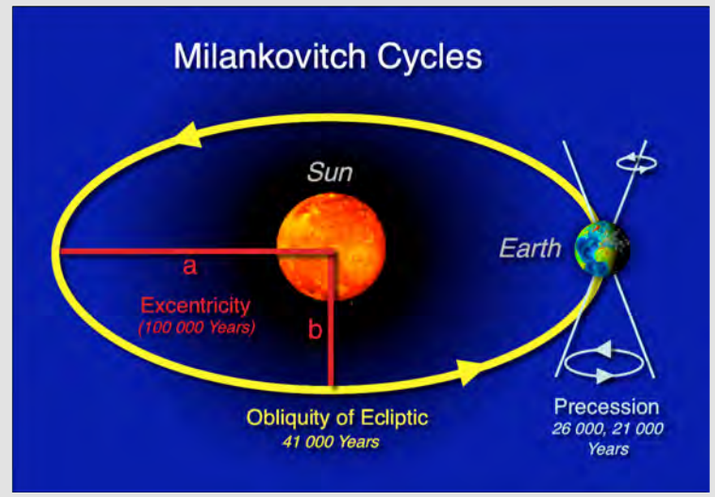
1. Snowballs and Hothouses: Climate Change over Geologic Time

Global climate has changed a lot over Earth's history. At least twice during the Proterozoic (2.5 billion to 543 million years ago) global temperatures plunged, and ice may have covered the planet. At other times in the Earth history, climate was much warmer, with no ice caps or glaciers at all. Many natural forces contributed to these changes over geologic time, including variations in solar output, the configuration of continents, ocean currents, and volcanic eruptions. Life, too, has altered global climate by absorbing or emitting carbon in the atmosphere. What is different about current climate change is that it is anthropogenic (that is, man-made).

2. A Break in the Ice Ages

The orbital cycles that brought the Earth in and out of ice ages since the Pleistocene are known as Milankovic Cycles, after their discoverer, the Serbian mathematician Milutin Milankovic (1879-1958). Based on these cycles, the Earth should be cooling now, not warming.

Humans evolved during the Pleistocene Epoch, a cold time in Earth history marked by long ice ages and shorter, warmer interglacial periods. The rise of agriculture and civilizations began around 11,000 years ago with the start of the most recent



The orbital cycles that brought the Earth in and out of ice ages since the Pleistocene are known as Milankovic Cycles, after their discoverer, the Serbian mathematician Milutin Milankovic (1879-1958). Based on these cycles, the Earth should be cooling now, not warming. (Source: Wikimedia Commons)

interglacial, which we call the Holocene. Long cycles in the Earth's orbit have driven these glacial-interglacial cycles. These cycles do not, however, explain recent global warming.

3. The Cooling before Global Warming

Global climate has varied during the Holocene. Temperatures were probably warmest more than 6,000 years ago, and then began to gradually fall. The coldest period in the last few thousand years was the "Little Ice Age" that started around 1400 CE. This natural cooling was much smaller than projections for warming in the 21st century. However, before modern technologies, people were more vulnerable to untimely cold and

Frozen winter landscapes, such as this scene by Hendrick Avercamp, were a typical feature of the coldest phase of the Little Ice Age from the late 1500s to the late 1600s. (Source: Wikipedia)

drought typical of the Little Ice Age, especially after big volcanic eruptions. Recent historical research implicates the Little Ice Age in famines, rebellions, and wars particularly in the late 1500s and 1600s.

4. Entering the Anthropocene

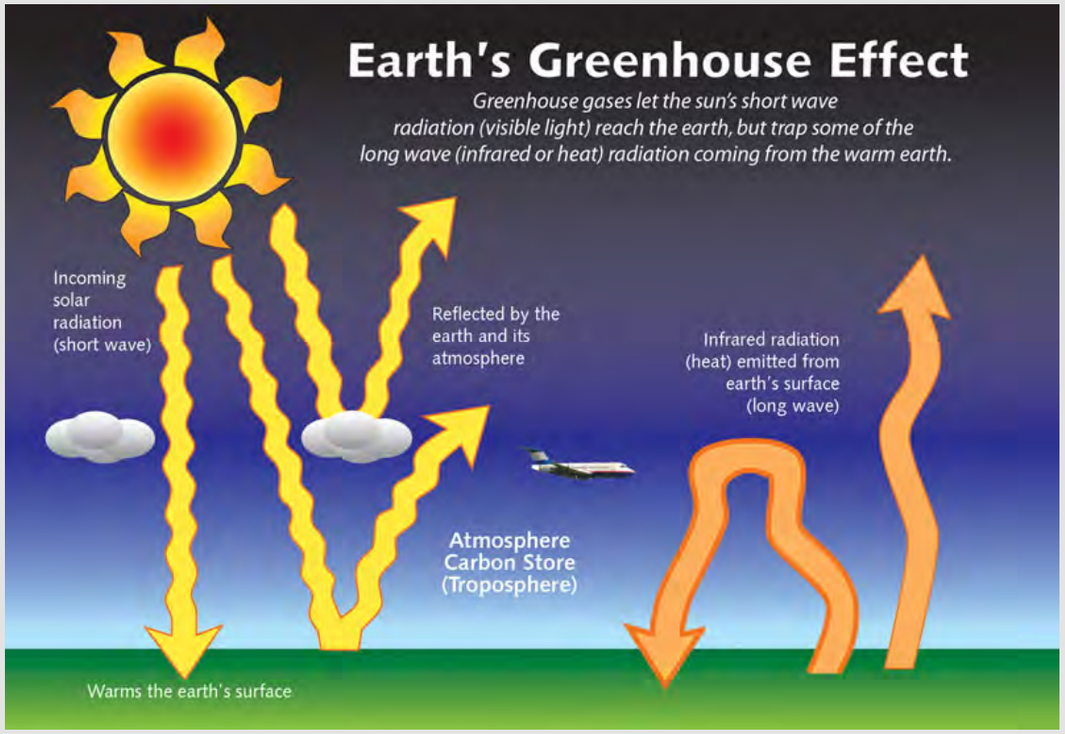
Starting with Britain's Industrial Revolution around 1800, more countries began to burn coal and later oil and gas for heating and energy. By the late 1800s, emissions from burning fossil fuels—and from deforestation, agriculture, and livestock—began to change global climate, bringing the Little Ice Age to an end. Industrial technologies also sped up the global extraction of

Coal-fired industries such as smelting, as illustrated in this 1801 painting, gradually emitted enough greenhouse gasses into the atmosphere to warm global climate and end the Little Ice Age. (Source: Wikipedia)

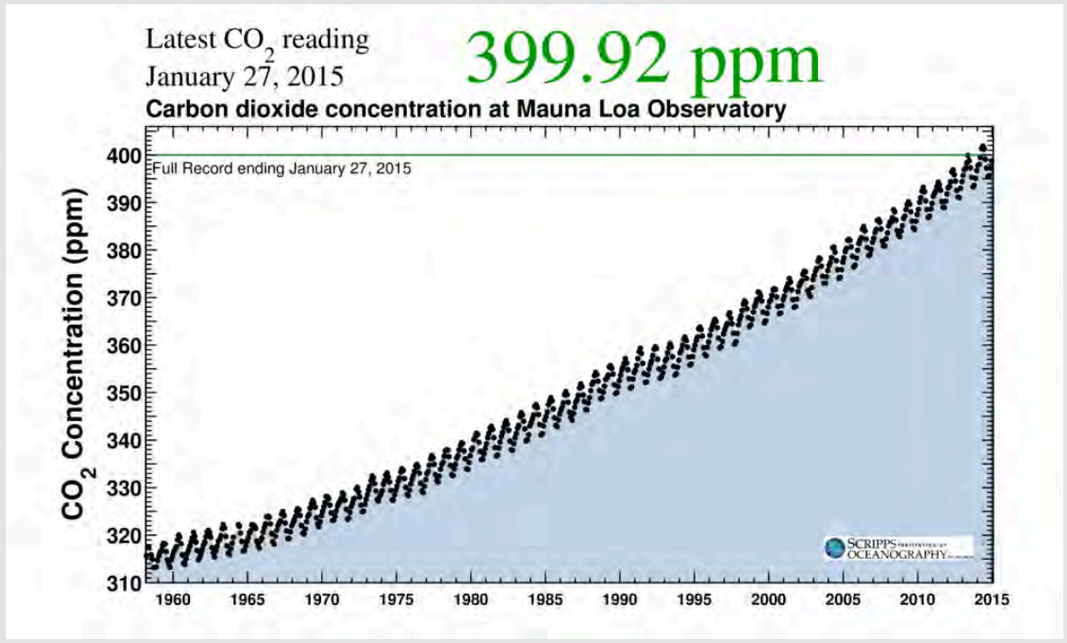
resources and movement of people, plants, and animals across the planet. The accelerating human impact on the environment has led some geologists to argue we have left the Holocene and entered the Anthropocene, or "Human Age."

5. Predicting Global Warming

By the mid-1800s, scientists began to discover how burning fossil fuels could change global climate. In 1859, John Tyndall proved experimentally that carbon dioxide and water vapor trapped heat by letting in shortwave radiation and reflecting back long-wave radiation (see picture). In 1896, Svante Arrhenius calculated that



This diagram above is a simple illustration of the earth's greenhouse effect. (Source: New York State Department of Environmental Conservation)



The Mauna Loa observatory has measured atmospheric CO2 levels since 1960, producing the famous "Keeling Curve." (Source: Wikipedia)

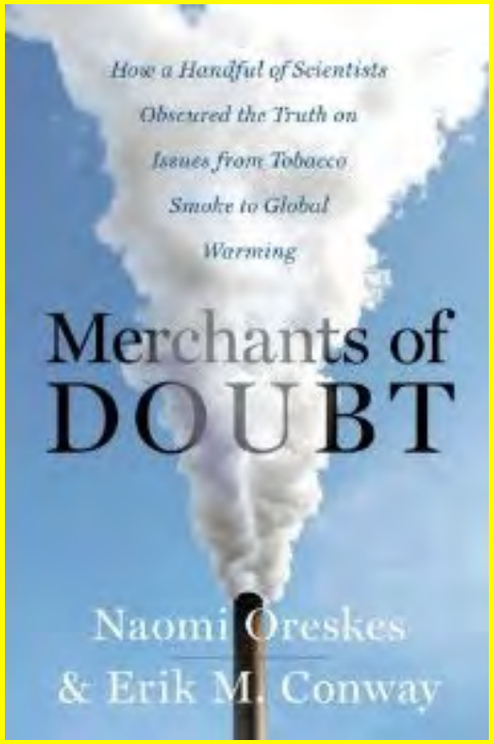
burning coal could substantially raise average global temperatures. In the late 1930s, British engineer Guy Stewart Callendar observed that temperatures were already rising and pointed to more greenhouse gasses as the cause.

6. Discovering Global Warming

From the 1950s to 1990s, new discoveries gradually turned anthropogenic climate change from a tentative theory into a firm scientific consensus. Researchers including Roger Revelle and Charles Keeling demonstrated that carbon dioxide levels in the atmosphere were rising. Better reconstructions of past climate—including from cores drilled deep into glaciers and ice sheets—have made it clear that greenhouse gasses drove rapid changes in global climate. Faster computers and better climate models have improved forecasts and emphasized that current warming must be anthropogenic, not part of natural cycles as was the case in the past.

7. Denying Global Warming

Even as evidence accumulated and climate scientists grew more alarmed, fossil fuel industries and allied lobbyists and think tanks worked to obscure and deny the science behind global warming. As investigated by Naomi Oreskes and Erik M. Conway in



Naomi Oreskes' and Erik M. Conway's Merchants of Doubt (2010). (Source: Wikimedia Commons)

Merchants of Doubt (2010), these efforts drew on many of the same tactics—and sometimes the same experts—employed by the tobacco lobby to deny links between smoking and cancer. By the 2000s, virtually all climate scientists agreed that human greenhouse gas emissions were changing the climate, but many Americans remained confused or uncertain.

8. Confronting Global Warming

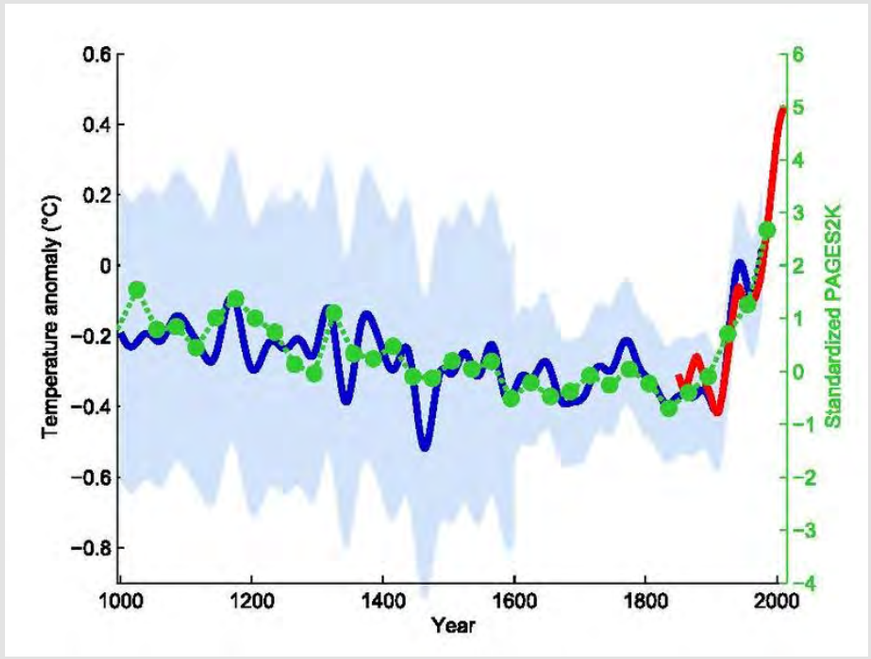
Climate change gradually gained attention as a major international issue. Since 1988, an Intergovernmental Panel on Climate Change (IPCC) has brought together global experts to report consensus measurements, estimates, and impacts of climate change. The 1997 Kyoto Protocol set the first international greenhouse gas targets, but the United States didn't join. Since then several United Nations summits have focused on

From the 2011 UN Climate Change Conference in Durban, South Africa. (Source: Wikimedia Commons)

climate change, but none has produced a binding global treaty. Rising public concern, falling costs for renewable energy, and recent commitments by the U.S. and China have raised hopes for more success at the next climate conference, Paris 2015.

9. The Acceleration of Global Warming

The Earth is already warming. The ten hottest years since instrumental measurements began have all occurred since 1998. The IPCC projects that without urgent reductions in greenhouse gas emissions, warming will exceed 2˚C (3.6˚F) by 2100, unleashing potentially catastrophic heat waves, droughts, and



The so-called "hockey stick" graph of Northern Hemisphere temperatures since 1000AD by climatologist Michael Mann and colleagues was controversial when first released in 1999. However, the temperature trend has been confirmed by many subsequent studies. (Source: Wikipedia)

sea level rise. In the last decade the U.S. and Europe have reduced emissions, but increases in China and India have been faster and more than offset reductions elsewhere on the planet.

10. The Complex Consequences of Climate Change

What climate change means for different people depends on location and circumstances. Regions threatened by rising sea levels, bigger storms, floods, and droughts could be more at risk.

The Syrian civil war, now in its fifth year, has devastated the country and displaced millions. Several studies have pointed to both a regional drought and a global spike in wheat prices in its outbreak. (Source: Wikipedia)

Poorer nations, for lack of resources, are more likely to struggle to adapt and build resilient economies and infrastructures. Historical examples suggest climate change will aggravate political instability, poverty, and conflict. Already some analysts have pointed to global warming and severe droughts in Syria and around the world as a contributing factor in the 2011 Arab Spring and Syrian civil war. The same has been said of the fighting in Sudan and Darfur. And with sea levels rising, countries like the Maldives (in the Indian Ocean) and Kiribati (in the Pacific) may simply disappear under water, leaving their populations refugees.

◆

A Postcard from Reykjavik: Iceland's Volcanic History (July 2015) Postcard

By PAUL NIEBRZYDOWSKI

Published July 2015.

Glacier flowing down Iceland's southern coast
(Source for all images: Author's photographs)

Humans weren't around when volcanoes formed Iceland's unique island landscapes some 20 million years ago. But in the 1,100 years that Iceland has seen settlement, the story of its volcanoes has been interwoven with human history. Although the data are incomplete, over 170 volcanic eruptions have been recorded in Iceland since the 10th century. Roughly 50 have occurred within the last 100 years.

Volcanic landscape

Recently, the Bárðarbunga volcano erupted in August of 2014. And when locals try to predict which volcano will go next, they focus on the Angry Sisters, Hekla and Katla, which erupted a century ago and are due—if volcanoes are creatures of habit—to erupt again soon. Katla sits underneath the Mýrdalsjökull glacier in the south and will trigger massive flooding when it resumes activity.

Luckily, no recent event has been as devastating as the 1783 eruption of the Laki volcanic fissure, a system of craters near present-day Vatnajökull National Park. That eruption lasted ten months, led to the death of over half of the island's livestock, and caused almost a quarter of Iceland's population to perish.

You didn't have to live in Iceland to feel the might of Lakagígar (the Craters of Laki). Environmental historians have begun to understand how the eighteenth-century Laki eruption affected the Indian Monsoon Current and contributed to food instability as far as Ottoman Egypt, causing between 2-6 million deaths worldwide. Descriptions of the eruption's effects appear even in Benjamin Franklin's diary.

Glacial melt from Myrdalsjökull glacier in the south (jökull means glacier in Icelandic). Note the alluvial cones formed by volcanic ash and sediment.

Þingvellir national park, just east of Reykjavik.

And, in our age of global travel and trade, ash clouds from Iceland continue to inflict trouble. Our most recent reminder came in 2010 when a cloud of ash from Eyjafjallajökull delayed flights globally for weeks.

Skógafoss, near Eyjafjallajökull, is one of many waterfalls seen from the Ring Road

Just as Iceland’s remote volcanoes can alter global weather patterns, distant human actions also affect the island. Rising global temperatures accelerate the melting of glaciers. And while glacial melt sustains the incredible array of waterfalls seen all along Iceland’s picturesque Ring Road (like Skógafoss, pictured),

Iceland's Ring Road, Highway 1, was completed in 1974 and circles the island in an 828 mile loop.

some speculate the reduction of glacial cover could promote more volcanic activity.

Despite its hostile reputation and proximity to the Arctic Circle, Iceland is no stranger to people, and its landscape tells a human story.

Since the 9th century, settlers have felled all of Iceland’s woodland, while their sheep and ponies have contributed to soil erosion. Iceland has picturesque black beaches (like Dyrhólaey), but soil quality generally poor for agriculture

A new arrival, the Alaskan Lupine, has taken over where few other species could survive. Most Icelanders welcome the invasive flower because it helps curb erosion and adds nitrogen to soil, making the southwestern regions where it has grown rampant more fertile.

Iceland may sound remote and unwelcoming, but tourists increasingly have begun to discover its beauty. Tourism has increased an average of almost 10% per year since 2000. The number of annual visitors doubled between 2000 and 2010, when

Hiking near Eyjafjallajökull

More sights along the Ring Road

Dyrholaey, southern tip of Iceland, boasts puffins and black volcanic beaches

half a million people visited the island. At this rate, Iceland's Tourism Board estimates one million people will visit the country in 2020.

With such an influx, humans will undoubtedly continue to reshape this volatile and volcanic, yet fragile environment. ◆

Black beach at Dyrholaey

Alaskan lupine (nootka) flowers, near Skaftafell.

Iceland's Westfjords as seen from the sea

The harbor in Reykjavik, Iceland's capital

Vik, along Iceland's Ring Road

Climate Change and Human Life *(Podcast)*

Delegates from across the globe will soon gather at the Paris Climate Change Conference, set to begin at the end of November. Sponsored by the United Nations Framework Convention on Climate Change, conference representatives will endeavor—not for the first time—to find ways to "stabilize greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system." On this episode of *History Talk*, three environmental historians, Sam White, John Brooke, and Nicholas Breyfogle, discuss past patterns of climate change—both recent and others from the deep planetary past—and what these historical processes of climate adaptation and survival tell us about humanity's prospects today. ◆

Published November 2015.

A hole in a iceberg near Sandersons Hope, Greenland. (Source: Kim Hansen on Wikimedia Commons)

Listen to this podcast on the web at http://origins.osu.edu/historytalk/climate-change-and-human-life

Climate Change, Russia, and the Race for the Arctic *(Podcast)*

In this *Origins* podcast of *Writers Talk History*, host Patrick Potyondy interviews historian and *Origins* editor Nicholas Breyfogle about the international race for the arctic. He tells us about the complex and perhaps explosive historical dimensions of climate change. ◆

Published February 2013.

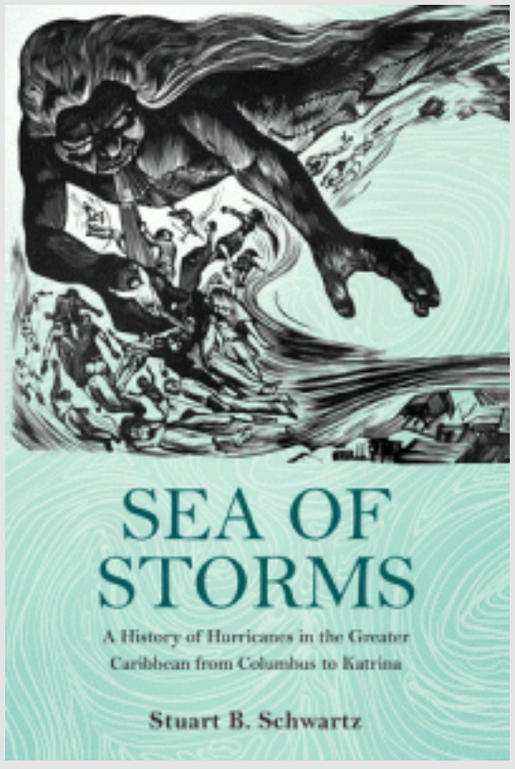
Listen to this podcast on the web at http://origins.osu.edu/sites/origins.osu.edu/files/history-talk/mp3/2013-02--Writers%20Talk-Origins-Breyfolge-Climate-Change-and-international-relations_0.mp3

President Vladimir Putin awards Artur Chilingarov the Hero of Russia Star. (Source: Wikimedia Commons and kremlin.ru)

Sea of Storms: A History of Hurricanes in the Greater Caribbean from Columbus to Katrina

Book review by
TIMOTHY C. LEECH

Published May 2015.



by Stuart B. Schwartz (Princeton University Press, 2015)

Hurricane Elena was responsible for the best meal I had as a college freshman. The 1985 hurricane skirted the Florida State University campus, taking down trees and utility lines before making landfall near Biloxi, Mississippi. A local grocery store lost power and had to give away the stock of meat it couldn't refrigerate. So my friends and I gorged ourselves on grilled steaks!

We were very fortunate—Caribbean hurricanes can pack tremendous destructive force. They are often terrifying and frequently deadly. In 1772, Alexander Hamilton while living on St. Croix eloquently described the impact of a major hurricane. Young Hamilton survived this encounter and went on to become the first Secretary of the Treasury of the United States.

Though the 1772 hurricane terrified Hamilton, many historians have generally ignored weather events, along with larger climatic patterns, geologic disasters like earthquakes, and outbreaks of disease as unimportant to historical scholarship. They looked at human events as only having human causes and discounted the possibility of other factors having a significant impact. But in recent years, historians have started to seriously consider how non-human forces have shaped historical events and trends. Two impressive examples are: *Climate Change and the Course of Global History: A Rough Journey* by John Brooke and *Global Crisis: War, Climate Change and*


Hurricane Elena photographed from Space Shuttle Discovery, September 1, 1985.(Source: Wikimedia Commons)

Catastrophe in the Seventeenth Century by Geoffrey Parker.

In *Sea of Storms: A History of Hurricanes in the Greater Caribbean from Columbus to Katrina*, author Stuart B. Schwartz is fundamentally inspired by a historian from an earlier generation, Fernand Braudel. In Braudel's magisterial study, *The Mediterranean and the Mediterranean World in the Age of Phillip II*, first written during the Second World War, he explores humanity's experience in the Mediterranean region over centuries across national and continental boundaries. Braudel conceived people and historical events as being profoundly shaped by the temperate, predictable Mediterranean climate.

Schwartz, like Braudel, explores an expansive geographic area, crossing political and cultural boundaries, over a span of centuries. But where Braudel saw climate and weather as stable and benign, Schwartz emphasizes the unpredictable but potentially devastating impact of Caribbean hurricanes.

Over a long and notable scholarly career, Schwartz has written and edited numerous books on the history of Latin America and Brazil especially as they were shaped by Spain and Portugal through exploration, trade, warfare, and colonization, including Africa, South America, Central America, the Caribbean, and parts of North America.

In *Sea of Storms*, Schwartz defines the "greater Caribbean" as extending from South America, westward to Mexico, and north as far as the Chesapeake Bay on the east coast of the United States. Throughout this vast region, he emphasizes two themes that have had long-term influences: the enduring legacy of plantation slavery leading to economic development at the cost of tremendous human suffering and the major role of the United States as the regional superpower starting at the end of the nineteenth century.

September 13, 1928 photograph depicting a ten foot long two by four driven through a palm tree by the winds of the San Felipe hurricane in Puerto Rico. Schwartz points out its similar appearance to the Christian Cross (p. 235). (Source: National Oceanic and Atmospheric Administration)

Through the five centuries covered by the book, people's perception of what hurricanes signified changed drastically. From the time of the Spanish conquest of the region, beginning in 1492, through to the 1700s, hurricanes were seen as God's wrath unleashed upon sinning humanity. Prayer and fasting were means to bring divine favor and protection from storms. The shift to a scientific

understanding of hurricanes started around 1700 when people began precisely measuring and formulating theories about them.

The modern system of measuring storm intensity on the category 1 through 5 scale was not developed until the 1970s. Thus historians depend largely on subjective reports of damage to estimate the intensity of earlier storms. In past centuries, many of the fatalities caused by hurricanes did not result directly from wind and storm-surge damage, but came about later due to starvation, thirst, and exposure. This was especially a problem on smaller islands where a single storm could wipe out major elements of the infrastructure for providing food, drinking water, and shelter.

The question of how societies and governments respond to disastrous hurricanes is central to Schwartz's study. Self-help, religious and secular charities, and government assistance have been employed consistently throughout the period to help people cope with catastrophic events. Varying factors have shaped relief efforts. These include technical capacity, economic resources, and ideology. Different attitudes towards the role of government sharply define the most recent chapters of the book. During the Cold War, the way different nations responded to hurricanes were used by Cold War foes to score propaganda points.

Watch this video on www.youtube.com

Schwartz attempts to integrate the experience of ordinary people into his story. But he struggles to cope with the challenging fact that slaves, peasants, and the poor have left very little in the way of historical documentation. So his story tends to emphasize the literate elites, charitable institutions, and government agencies, because these actors have left rich sources of evidence.

Schwartz does an outstanding job of balancing attention between earlier centuries and the contemporary period. He also demonstrates his historical range and linguistic capabilities by integrating evidence from Spanish, Portuguese, English, and other languages. This is absolutely vital given the diverse cultures that are all part of Caribbean history.

In addition to its emphasis on hurricanes, and how humanity has responded to them, *Sea of Storms* also provides a useful general summary of the history of the Caribbean. But for many readers, Schwartz's concluding discussion of current storms and policies is likely to be the most interesting part of the book. He points out that FEMA (the Federal Emergency Management Agency) was hampered by both budget cuts and a refocusing of its mission towards anti-terrorism prior to the Katrina disaster. He also looks at discussions of how human-caused climate change may influence the severity, frequency, and geographic reach of hurricanes.

Discussing the possibility that human-emitted greenhouse gases may be altering hurricane patterns allows Schwartz to bring his

story to a full circle. Five centuries ago people saw hurricanes as divine punishment upon sinful humanity. Now, we are again bearing some responsibility for hurricanes through our pollution of the atmosphere.

The 2015 Atlantic hurricane season starts on June first and runs through the end of November—stay tuned and stay safe! ◆

Ciclón, Santiago Álvarez's documentary on the Cuban response to 1963 Hurricane Flora, available via YouTube. (Images of death and suffering may be disturbing to some viewers).
https://youtu.be/aZlNv7-Ey1E

Chapter 3

Energy and Power

This array solar power matrix generates energy.
(Source: Flickr by David Goehring)

Energy Policy and the Long Transition in America

EDITOR'S NOTE:

Energy has been in the news lately: The natural gas industry appears to be developing a world market; the U.S. Army is experimenting with "alternative" and "renewable" energy sources; "green" and "conservation" are being marketed as sound corporate management strategies. A half century ago the emphasis on natural gas, alternative and renewable fuels, and conservation were not in the energy policy mix in the United States. The convergence of historical trends in the 1970s, however, ushered in a "long transition" in American energy policy-making that is on-going. This month historian William R. Childs untangles a few of the many complex strands that make up the history of energy policy in America.

Published November 2011.

*Update: How is the "Long Transition" from Fossil Fuels Doing?

By WILLIAM R. CHILDS

You can't read the newspapers or surf the web without coming face to face with the pivotal human problem of energy resources: what sources we should produce and consume, the environmental impacts, and who should control energy development.

Oil and coal dominated U.S. energy production in the twentieth century. Since the 1970s, America has been making a "long transition" away from carbon-based fuels toward new sources of energy and a different sensibility to consumption. (Source: National Archives)

"Fracking" has rejuvenated the natural gas industry, but some are attacking the process as unhealthy to humans and the environment.

The U.S. armed services have begun to experiment with "alternative" fuel sources in order to reduce battlefield deaths and rising fuel costs.

Corporations market themselves as firms dedicated to "energy conservation"—"green" companies whose management strategies rest on the efficiencies of "sustainability."

And when it comes to energy, much has changed in recent decades. A half century ago fracking, alternative fuels, energy conservation, and sustainability were neither everyday news items nor were they significant forces within American energy policy-making.

In the 1960s, carbon-based fuels sustained the ongoing postwar economic expansion. Coal-fired electric plants served factories and homes. Oil refineries produced fuels for transportation and petro-chemicals for consumer goods (such as plastics and fashions).

A convergence of historical trends in the 1970s, however, "shocked" American energy markets. From that point, energy policy-making entered what analysts call the ongoing "long transition" away from carbon-based fuels.

This long transition is characterized by two strands—deregulation of markets on the one hand, and an environmental sensibility, on the other hand, that recognizes that earlier policies, which encouraged increased consumption of carbon-based fuels, are no longer sustainable. Instead, around the globe, states, scientists, entrepreneurs, and consumers are emphasizing different approaches to developing energy sources that sustain this more recent environmental perspective.

This long transition, however, is not complete, coherent, nor accepted by all interests involved in energy policy-making in the U.S. The fact is that coal still dominates our electric generation and oil still drives transportation. As has been the case since the beginning of the industrial revolution in the early 19th century, there is a lot of both still to be mined and produced around the world, while the prices of both remain lower than alternative sources.

Comprehending the complexities behind energy policy-making is a daunting task. A recently published book that attempts this, Daniel Yergin's *The Quest: Energy, Security, and the Remaking of the Modern World*, is 800 pages long and covers only the last 20 years. And some reviewers point out that this world-renowned expert's analyses are incomplete!

By focusing here on four themes—the *paradox of abundance*, the *patterns of regulation*, the *transition decade of the 1970s*, and the *parameters of the long transition*—we can untangle a few of the many complex strands that make up the history of energy policy in America. And that, I hope, will enable readers to conclude for themselves whether and how future energy needs will be met—or not.

Generally speaking, much of the economics and politics that shaped energy policy-making before the 1970s continue to influence the story. There is one major difference, however. The environmentalism that emerged in the 1970s has promoted multiple, new approaches to policy-making and ways of thinking

about energy, including attempts to conserve energy, reduce pollution, and improve public health.

The Paradox of Abundance

Energy policy involves how people decide to use the available natural resources that make up energy markets. A central tension sits at its heart.

A pump jack pumping an oil well near Lubbock, Texas. (Source: Wikimedia Commons by Flcelloguy)

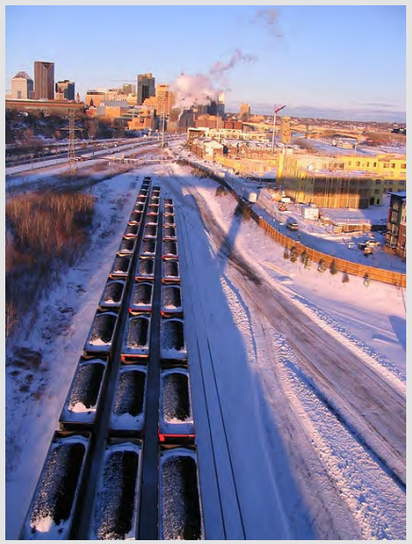
On the one hand, following from the concept "the commons," natural resources are seen as belonging to every citizen, and every citizen has the right to participate in deciding how they are used. On the other hand, in the American economic system, we have given to entrepreneurs and private interests the right to extract natural resources, process them into useable things or services, and make money from that process, sometimes even subsidizing them, as long as they follow rules established by the political process.

American energy policy has floundered at times on the inherent conflicts between joint ownership and the exploitation of natural resources by private interests. How much should be exploited now? How much should be conserved for future generations? Who should govern the exploitation and the conservation? Should public or private interests be privileged?

Complicating the question of control over natural resources is the fact that the U.S. has enjoyed an abundance of energy throughout its history: from the founding of the country in the 18th century (wood and water for heating and small-scale manufacturing), to the 19th and early 20th centuries (coal and water for steam engines and electric generators for manufacturing, lighting, home heating and cooking), to the mid-20th century and beyond (oil for transportation and nuclear-powered electricity and natural gas for heating and cooking).

This existence of abundant energy has masked another fact, that the U.S. has long utilized a mix of energy sources, and that mix has changed over time.

For example, even though petroleum has appeared to be the dominant fuel of the 20th century, the consumption of coal has increased to the point that in 2011 coal-fired plants still generate about 50 percent of the electricity in the U.S. Production of electricity



Coal cars pass through St. Paul, Minnesota. (Source: Creative Commons by Greg Woodfill)

from hydro-electric dams, which expanded from the 1930s to 1970s, has declined as a percentage of total electricity production since the 1980s in part because environmental groups have successfully argued that the dams constructed earlier in the century were unnecessary and damaged the environment.

Nuclear power is potentially unlimited, yet sustains only 20% of America's electrical production. (That percentage compares in interesting ways with other nations. France, for example produces 75% of its electricity through nuclear plants.) Some predict, moreover, that over the next several decades natural gas will overtake coal as the fuel of choice for electricity generation.

Thus, there has long been and continues to be an abundance of energy sources. Americans have structured the mix of these abundant natural resources according to the unique costs of production and distribution and interest-group political influences.

Patterns of Energy Regulation

Energy regulation has encompassed two separate but related regulatory stories—the regulation of electricity and natural gas systems and the regulation of the oil industry. The former involved domestic policy, while the latter connected domestic issues with international developments.

The regulation of electricity and natural gas systems began in the late 19th century, and expanded throughout the 20th century as more Americans moved to urban areas. Various interest groups—some representing the competing interests within the coal, oil, and natural gas industries, and others representing various consumers' groups—clashed in the political arena to determine levels of private and public control over energy resources.

These clashes resulted in a regulatory era in which municipal, state, and national commissions shaped the markets in two general ways.

First, regulators *promoted industry interests*. They restricted competition, guaranteed returns on investment, and encouraged expansion of services. Second, these actions enabled regulators to better *protect consumers*. In exchange for shielding the utilities from competition, regulators insisted that they furnish reliable, abundant, and cheap energy to all consumers desiring service.

That was the theory, at least. In fact, regulators faced difficult tasks because the economic structures of electric utilities and natural gas utilities were complex and disparate. As a result, energy regulation happened on an industry-by-industry basis, with no real attempt to coordinate policies across the entire market.

Sometimes government actions expanded markets to consumers at low prices (Tennessee Valley Authority and Rural Electrification Administration in the 1930s); and sometimes government policy

Cygnet, Ohio was a booming oil town with 13 saloons and many workers when this photo was taken in 1885. (Source: Ohio Department of Natural Resources, Division of Geological Survey)

undermined the market with ill-chosen policies (regulation of natural gas and nuclear plant construction in the postwar era).

The regulation of oil occurred at the same time as the regulation of electricity and natural gas, but remained mostly a separate policy story (even though oil and gas were often produced from the same wells).

In the late 19th century, after kerosene was overtaken by electricity as the main source of lighting in American homes, oil industry entrepreneurs transformed their operations to serve the internal combustion engine and transportation interests (autos and trucks, ships, and airplanes).

Beginning in earnest in the 1920s, and continuing into the mid-20th century, automobile clubs and the tourist industry supported gasoline taxes to expand construction of highways across the country. Over the same period, various interest groups, including the states, oil producers, and consumers, created a regulatory policy that *matched oil supply to demand* and *kept retail gas prices low*.

In matching oil supply to demand, regulators stopped the "boom and bust" cycle of crude oil markets where overproduction drove down the price of oil below the costs of drilling and production.

The regulatory policy was defended on the basis of "conservation": Booms often resulted in economic waste (oil was sold at less than its real value) and physical waste (the oil would not be available in the future). Yet, the conservation argument was undermined by other energy policies that ensured that retail gasoline prices remained low. Low prices stimulated more demand, which encouraged more drilling and production.

The emphasis on increasing demand through maintaining low prices not only frustrated conservation efforts, it also forced Americans to seek more oil from foreign sources as domestic production could not keep up with growing demand.

This turnaround occurred rather quickly. During World War II, what some have labeled the "war of oil," the United States produced and refined all of the oil needed by the Allies. In the mid-1950s

A U.S. oil tanker in the Mediterranean Sea during World War II. (Source: US Navy)

the U.S. produced enough oil to help supply Europe when Middle East supplies were disrupted during the Suez Crisis.By the 1960s, Middle Eastern and African oil producers began to work among themselves and with other nations to establish an oil cartel to control the price of oil worldwide.

In the mid-20th century, then, the American domestic oil market became intertwined with the world market. Domestic electric and natural gas markets, moreover, were narrowly focused on stimulating consumption, maintaining low prices, and relying on mostly carbon-based energy sources.

Transition Decade of the 1970s

By the 1970s, American domestic energy policy and the world-wide oil market lurched toward a two-pronged crisis that rocked American politics. One crisis was self-inflicted and led to some reform of natural gas policy; the other was connected to broader historical trends (anti-colonialism, decolonization, and the Cold War) and reshaped the world market for crude oil.

From the late 1940s through the 1960s Congress and five presidents failed to shape effective policy for promoting and regulating natural gas. Consequently, in the 1970s, shortages of natural gas plagued the Midwest and Northeast while consumers in the Southwest had plenty of gas, but paid high prices.

State and federal officials struggled to shift natural gas supplies to areas that needed the fuel during winter cold spells. In some cases regulators ordered gas curtailments to manufacturers to ensure heat was available to consumers' homes. Meanwhile, natural gas producers claimed that incentives (i.e., prices) were not high enough to pay for exploration for new sources. This failure of the regulated natural gas market disrupted local economies, which affected the national economy.

Meanwhile, in the international arena, oil-producing nations belonging to the oil cartel, the Organization of Petroleum Exporting Countries (OPEC), attempted to wrest control of their natural resources from western oil companies. OPEC employed its cartel muscle to withhold oil supplies to the U.S. and Western Europe, and to raise prices across the board. These cooperative actions, in 1973 and again in 1979, led to higher gasoline prices and in some cases, if only temporarily, no gas at all.

These "oil shocks," along with the shortages in natural gas supplies, prompted much discussion in America about energy. From one perspective, the economics of energy, interest-group politics, and industry-specific approaches continued to shape legislation.

From another perspective, though, Americans began in a halting fashion to develop new and broader approaches to natural resources policy-making. The 1970s marked the beginning of the long transition.

Deregulation and Environmentalism

In addition to the usual forces shaping the political economy of energy, two new forces emerged to shape responses to the crises of the 1970s: deregulation and environmentalism. Both are ongoing today, although with different impacts.

"Deregulation" began as early as the 1950s, but really gained traction in the 1970s and became a broad-based approach to reforming business-government relations in America.

In part a political, ideological attack on the New Deal, the movement was also a pragmatic response to problems with regulation (complex and time-consuming regulatory procedures increased costs to businesses and consumers, and hindered innovation in the marketplace).

Following in the footsteps of state and national deregulation of trucking, airlines, and banking, some states and the national government tentatively deregulated energy industries in the late 1970s, 1980s and 1990s. Not every state participated in electric deregulation, and there was no overall coordination among states and between states and the federal government.

Deregulation of natural gas was not comprehensive either.

The one clear failure of state deregulation in California—precipitated in part by the actions of Houston-based Enron—dampened enthusiasm elsewhere for deregulation.

While deregulation of energy producers has not created the success of deregulation that has been seen in other industries (or, with the exception of Enron, the huge problems of other deregulated industries), the programs have shown modest increases in participation year after year in those states where it has not been abandoned.

Arguably, however, one piece of deregulatory legislation may have trumped all other deregulatory efforts in terms of its later impact on natural resource policy. Over time, the freedom from regulatory oversight included in the Natural Gas Policy Act of 1978 has encouraged exploration for new natural gas sources.

More significant than deregulation to the evolution of energy policy has been the impact of **environmentalism**. During the mid-20th century, the modern environmental movement grew at

the state and national levels. Various interest groups (scientists and outdoor enthusiasts, including fisherman, hunters, and hikers) exerted political pressure to clean up America's air, water, and land, which had been despoiled by the carbon-based manufacturing and transportation economies during the previous century.

Drastic increases in pollution began with the industrial revolution, but it was the economic expansion during World War II and the postwar era—including the expansion of chemical industries—and its effects on natural resources and public health that underlay the emergence of the environmental movement.

President Barack Obama talks at the DeSoto Next Generation Solar Energy Center in October 2009. (Source: Wikimedia Commons)

Parameters of the Long Transition

The crises of the 1970s combined with modern environmentalism to create the "long transition" away from a reliance solely on carbon-based energy sources to a more comprehensive approach to the mix of energy sources.

The National Environmental Policy Act, the Environmental Protection Agency (EPA), and the Clean Air Act—all coming in 1970—kicked off a decade of environmental policy-making. Working with the states, the EPA created a more comprehensive approach to reducing pollution nationwide, which affected energy policy.

Following experience gained at the state level in California, the national government prodded auto manufacturers to design and produce lighter autos and cleaner and more fuel-efficient engines. Renewal of environmental legislation in 1990 sustained this new approach to natural resource management, and that led to changes in energy policy. To cite one notable example,

Brazos Wind Farm, also known as the Green Mountain Energy Wind Farm. (Source: Wikimedia Commons)

General Motors Urban Electric Car gets a battery charge from an outlet in the parking lot at the first symposium on low pollution power systems development held at the Mariott Motor Inn, Ann Arbor, Michigan, in 1973. (Source: National Records and Archives Administration)

coal plants in the Midwest joined a variety of programs designed to reduce acid rain, which had polluted New England waterways, farms, and cities.

Other approaches have met success in reducing the pollution from coal-fired electric plants. Beyond Coal, sponsored by the Sierra Club and Bloomberg Philanthropies, has targeted coal-fired plants on the basis of health issues. Efforts have forced some plants to shut down and prodded owners of existing and new coal-fired plants to reduce toxic emissions.

In addition to reducing carbon-based pollution, the long transition has been distinguished by more interest in pursuing a variety of approaches to producing energy than ever before. Renewable and "clean" sources, particularly wind and solar but also natural gas, and in some people's minds, "clean coal," have become increasing portions of the mix. Still, developing a variety of options to reduce reliance on carbon-based fuels has not been easy.

Alternative fuels are used mostly for transportation and include biodiesel, ethanol, hydrogen, electric, natural gas and propane. Promoted by special interests, including environmentalists, industrialists, and farmers, some of these fuels consume as much or more in fossil fuels to be produced as the energy they provide. And some of them exude high concentrations of pollution when they are used.

One of the most contentious alternatives is ethanol; it is produced from corn, requires lots of energy to produce, and has raised the price of corn, altering the world-wide food balance.

Electric cars, which have received much media attention, present environmental challenges even as they reduce reliance on carbon-based sources. More electricity will be required, and disposal of batteries may present environmental problems.

The long transition has been simultaneously promoted and undermined by one long-standing myth, that the world has passed the point of "peak oil." That term describes the point where discovery and production of oil no longer exceed consumption but rather begin to decline relative to the increase in demand. Eventually, given this scenario, our autos and trucks would run out of gasoline and diesel.

The peak oil argument reflects both a constant refrain in the history of oil and the basic boom-and-bust cycles of the industry. Since the early 20th century, petroleum analysts have predicted periodically that the nation would run out of oil. Again and again, however, more oil has been discovered and produced than was thought available.

Technologically improved methods of drilling (e.g., horizontal drilling) are producing oil from old fields many thought were dry. Deep-sea drilling techniques enable oil companies to extract petroleum from pools tens of thousands of feet below the surface of the sea.

So, the argument that the world has hit "peak oil" is irrelevant in the short and medium term because there is enough oil available with current drilling techniques to supply the world for several generations. Ironically, of course, the efforts to improve energy efficiency through conservation, green construction, and smart grids will help sustain the dominance of oil.

That oil is bought and sold in a global market, moreover, will ensure that the U.S. remains involved in the politics of international oil. (The same argument can be made for "peak coal," from which the peak oil argument derived.)

In addition to the peak oil argument, the long transition has been shaped, most recently, by the notion of "energy independence." Especially after the terrorist attacks on the U.S. on September 11, 2001, some advocates have championed "energy independence" as a worthy policy goal. They hope to break the Middle East's alleged hold on Americans' reliance on oil.

This political movement has promoted expanded drilling for oil that could unnecessarily harm the environment (e.g., drilling in the Arctic Refuge). Americans are not as tied to Middle East oil supplies as proponents of energy independence allege. The U.S. receives most of its "foreign" oil from Canada; more oil arrives in the U.S. from Africa than from the Middle East.

So, how dependent are we on foreign oil? While there is a connection to Middle East oil—American diplomatic and military involvement in the Middle East (Suez Crisis of 1956 ;Kuwait, 1989-1990) has involved protecting oil supplies *for Europe and Japan*, not necessarily for the U.S.—the connection is not as strong to the domestic market as some believe.

"Energy independence" remains an elusive dream unless Americans are willing to discard the automobile culture in favor of a drastically different transportation system. If that unlikely cultural revolution were to happen, it would take years to complete.

Natural Gas and the Future of American Energy

Protestors demonstrate against fracking in New York. (Source: Owen Crowley)

Perhaps it is appropriate to end with mention of the most recent media focus on energy. Natural gas appears to be on the threshold of becoming a major energy supply, not only as a substitute for coal-fired electric plants, but also as a substitute for nuclear power, an especially appealing alternative to some given the problems in Japan earlier this year. Natural gas also shows promise for fueling the transportation system.

In part, the deregulation of natural gas industry that began in 1978 encouraged this expansion, but that is not the entire story. There is rarely in history a singular cause; the origins of the natural gas resurgence are more complex.

Until recently, the lack of a worldwide market for natural gas, as well as access to abundant reserves, have prevented it from assuming a larger portion of the energy mix. Both of those impediments seem to be dissolving. CNG (compressed natural gas) and LNG (liquefied natural gas) are enabling natural gas to be transported over long distances in a world market. While the costs to construct CNG and LNG terminals are high, they are falling as more transference hubs and transport ships are built.

Polar bears in the Arctic National Wildlife Refuge. (Source: Wikipedia)

The media, however, have focused more on the expansion of natural gas production through hydraulic fracturing. Commonly known as "fracking," this is an old technology updated to unleash large amounts of natural gas previously unreachable in various shale formations in the U.S. and elsewhere, especially Europe.

Not surprisingly, given the historical trends noted above, there are some problems associated with natural gas increasing its portion of the energy mix. Increased use of natural gas to produce

electricity, furnish heating and cooking in homes, and fuel autos and trucks might add to the effects of global warming.

Fracking, moreover, is not necessarily "clean" when it comes to environmental threats to the land and water supplies. A consensus is building, though, that these issues can be addressed. Even industry interests concede that drilling techniques, including fracking, should be and can be environmentally safe. This emphasis on the environment clearly distinguishes the latest period of the long transition from earlier times when environmental issues were not in the forefront of policy discussions.

In conclusion, environmental politics have made a difference in energy policy-making since the 1970s, shaping the long transition in new ways. Energy-related pollution has been reduced; conservation and sustainability are more accepted and promoted in legislation (e.g., see the American Recovery and Reinvestment Act of 2009); and the largest retail business in the world, Walmart, has become a leader in sustainability-based business practices. Industry firms and interest groups are taking on "green" personas on their web sites.

For the foreseeable future, however, the economics of alternative sources, sustainable fuels, and clean energy will hinge on the price of coal and petroleum, and given the immense supplies of both, the interest group influences, and ideologically based politics, the long transition will likely continue for some time. ◆

Suggested Reading

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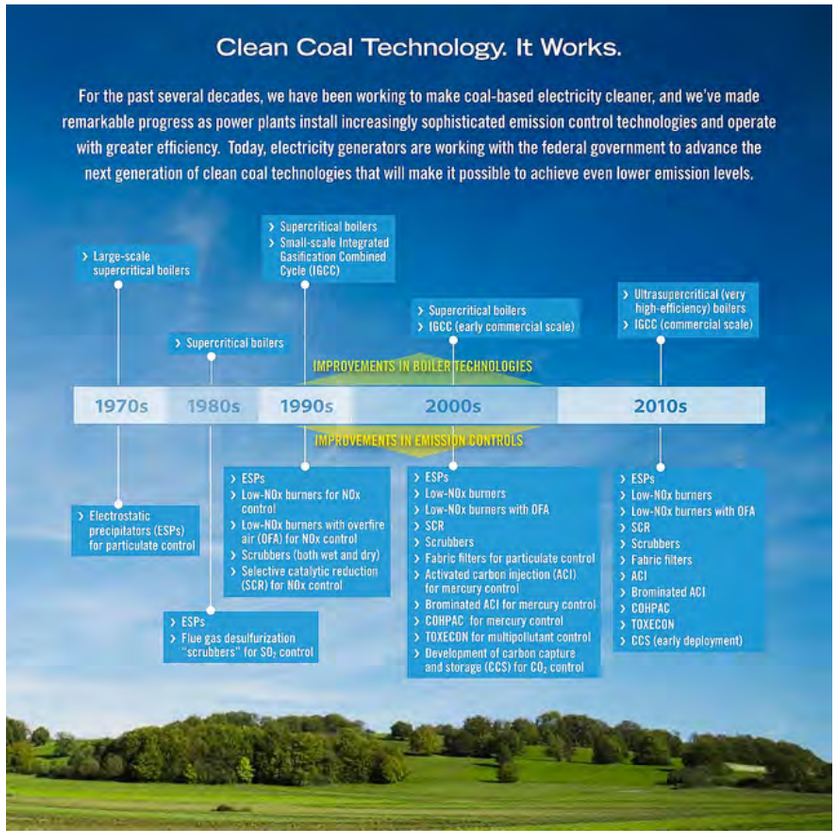
The White House. *Energy and Environment.* http://www.whitehouse.gov/issues/energy-and-environment Outlines current (2011) approaches to energy policy, with emphasis on sustainability and alternative fuels development.

Maps and Charts

"Clean coal" proponents produce advertisements such as this timeline coupled with images of clean, healthy landscapes.

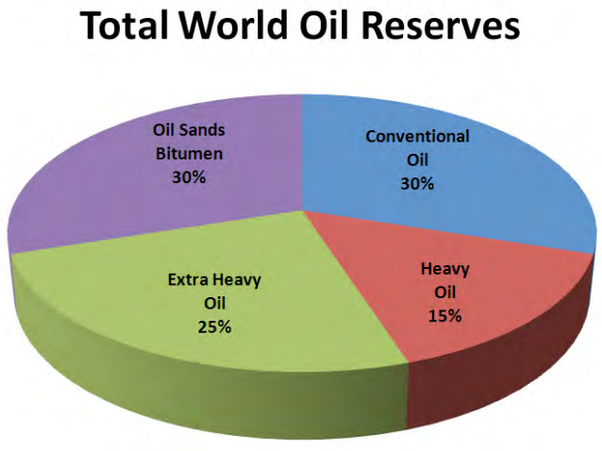


(Source: America's Power)

Countries belonging to OPEC, the Organization of Petroleum Exporting Countries

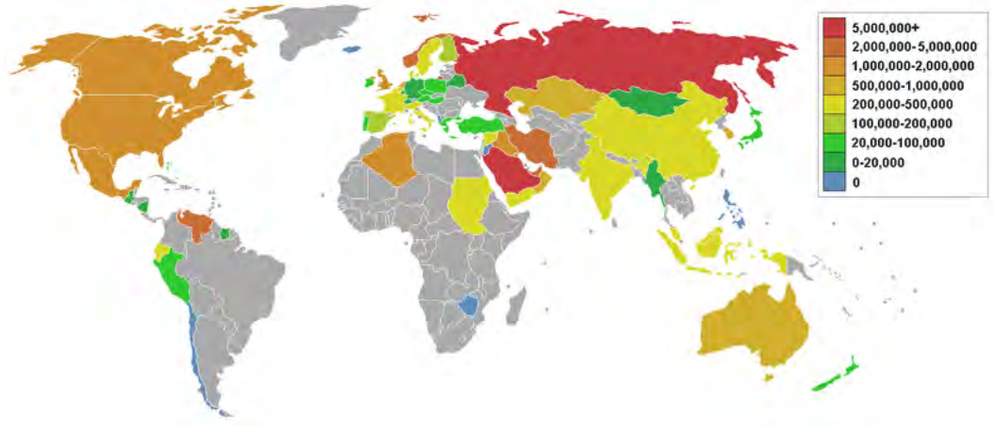
(Source: Wikimedia Commons)

Non-conventional oils make up most of the world's reserves

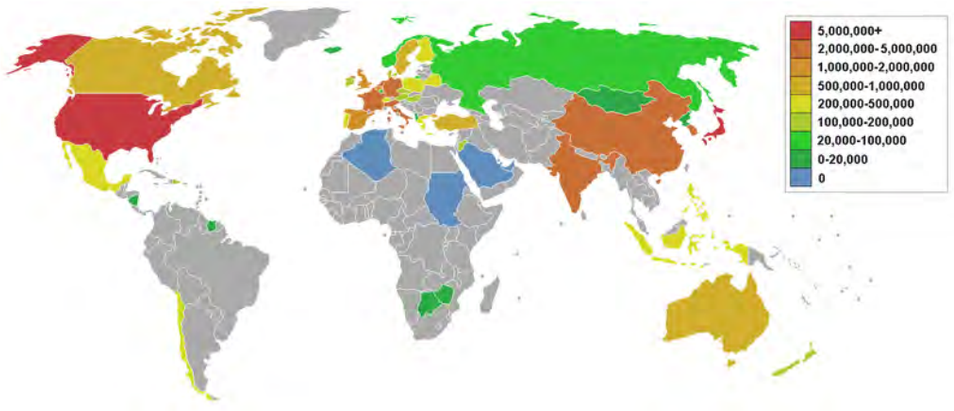


(Source: RockyMtnGuy at en.wikipedia)

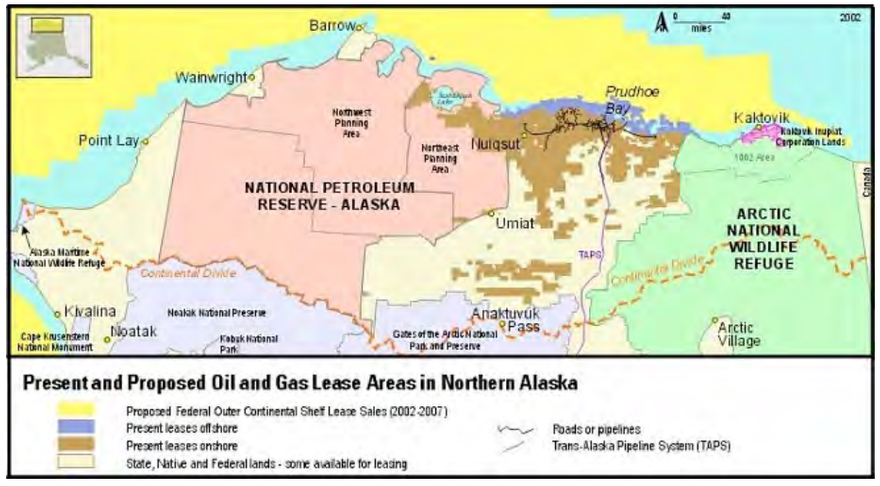
Oil exports by country



Oil imports by country



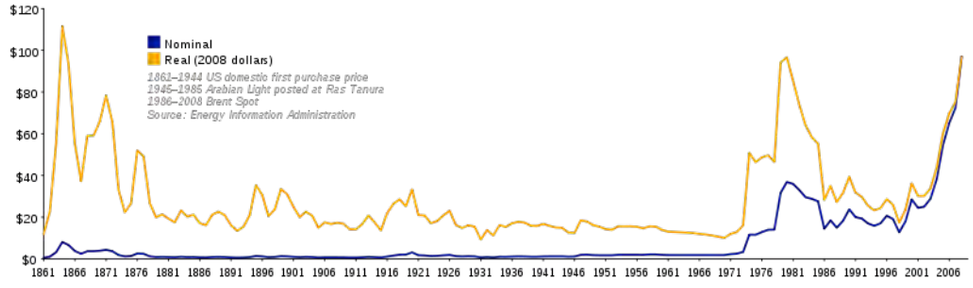
Present and proposed oil and gas lease areas in Northern Alaska



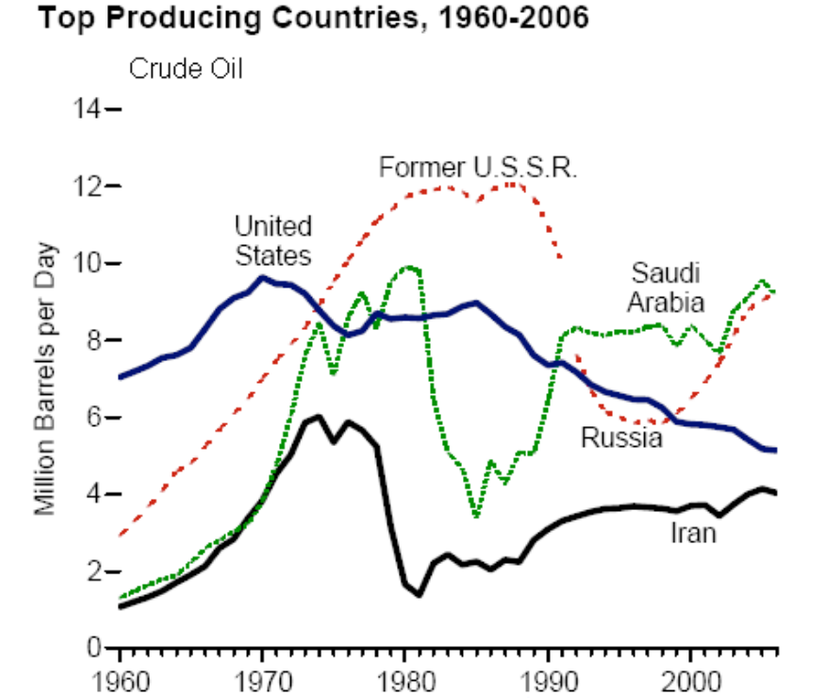
U.S. hydroelectric power generated by year (in blue), and hydropower as a percentage of all US electricity generated (in red).

(Source: U.S. Energy Information Administration)

Oil prices, 1861-2007

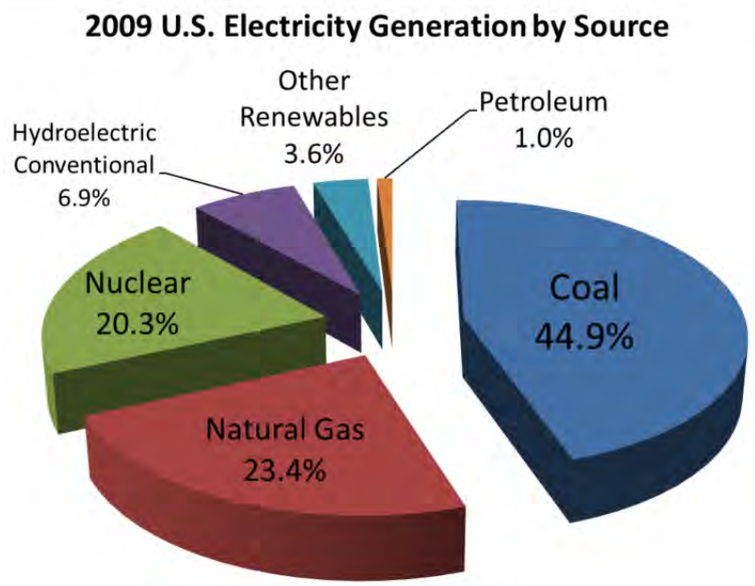


Top oil-producing countries, 1960-2006



Source: US DOE, Energy Information Administration
Annual Energy Review 2006

U.S. electricity sources, 2008

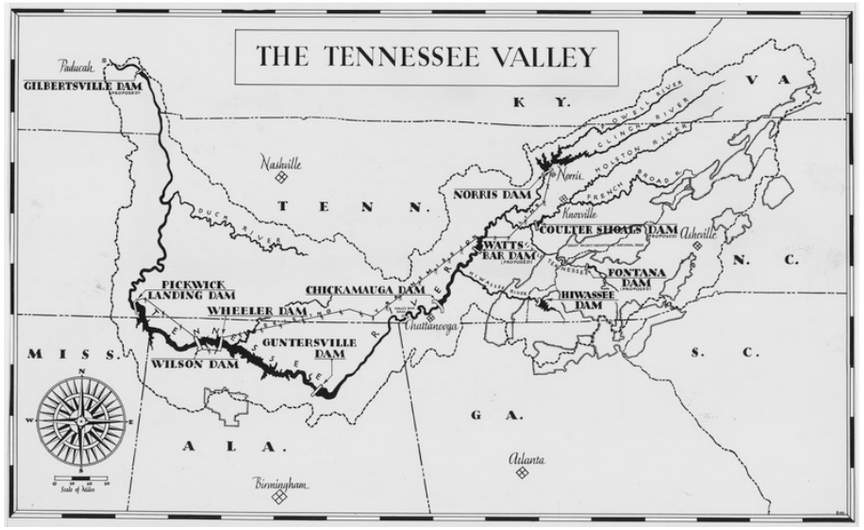


(Source: U.S. Dept. of Energy)

This map shows the extent of the oil sands in Alberta, Canada. The three oil sand deposits are known as the Athabasca Oil Sands, the Cold Lake Oil Sands, and the Peace River Oil Sands.

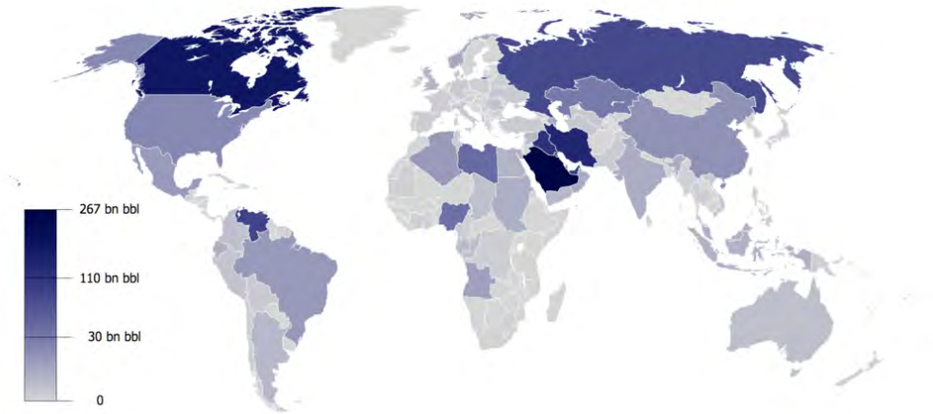
(Source: Norman Einstein)

The geography of the Tennessee Valley Authority

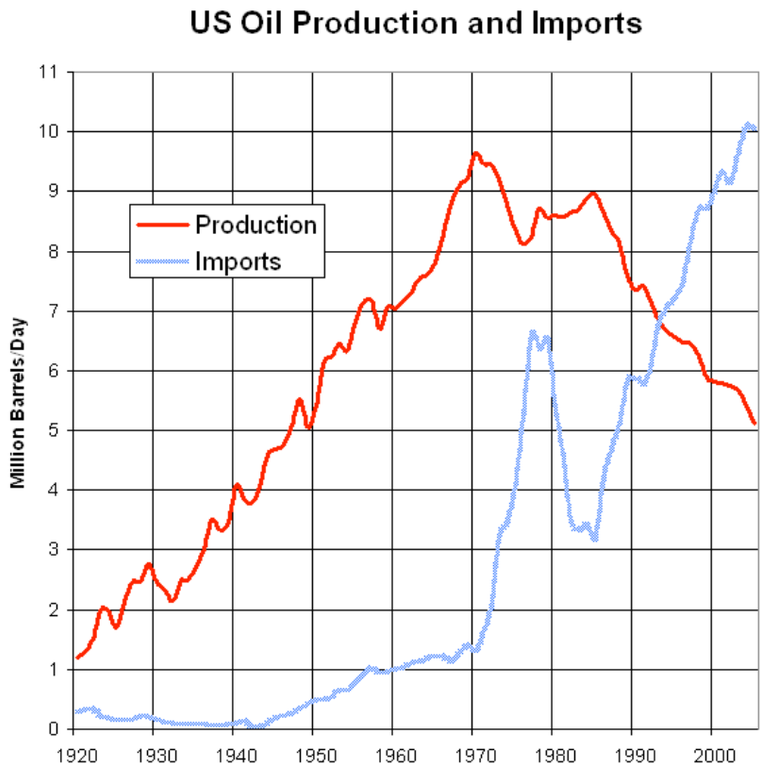


(Source: National Records and Archives Administration)

Proven world oil reserves as of 2009

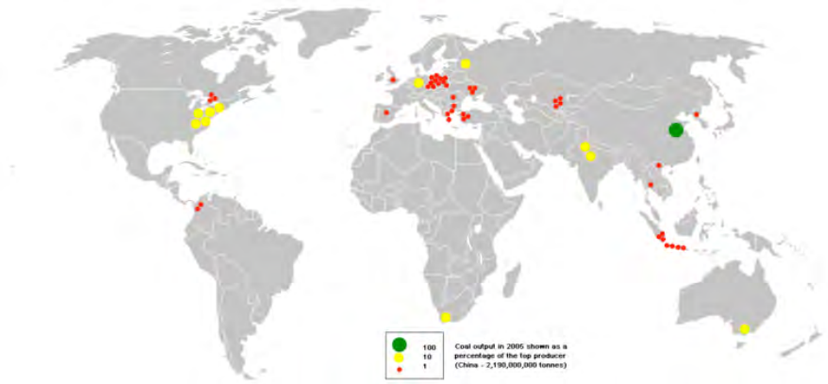


U.S. oil production and imports, 1920-2005



(Source: U.S. Dept. of Energy)

World coal output in 2005



(Source: British Geological Survey)

Additional Images

A modern electric car in France

(Source: Ian Britton)

A offshore oil drilling rig in the North Sea

(Source: Erik Christensen)

A post card from Galicia, dated 1881

(Source: Public Domain)

A sample of medium heavy crude oil

(Source: Wikipedia by Glasbruch2007)

A Wyoming strip mine

(Source: Bureau of Land Management)

Aerial image of a coal fly ash slurry spill in Kingston, Tennessee, taken the day after the spill in December 2008

(Source: Tennessee Valley Authority)

An oil field in California, 1938

(Source: U.S. Library of Congress)

Athabasca oil sands, sometime between 1900 and 1930

(Source: Library and Archives Canada)

Canadian protesters object to expansion of oil projects on Parliament Hill in Ottawa in September 2011

(Source: photo by Peter Blanchard)

Coke oven at a smokeless fuel plant in Wales, United Kingdom

(Source: Velela)

Protestors demonstrate against fracking in New York

(Source: Owen Crowley)

President Barack Obama talks at the DeSoto Next Generation Solar Energy Center in October 2009.

(Source: White House Photographer Jesse Lee)

President Barack Obama, Col. Dave Belote, and Sen. Harry Reid tour the Nellis Air Force Base photovoltaic array

(Source: U.S. Air Force by Nadine Y. Barclay)

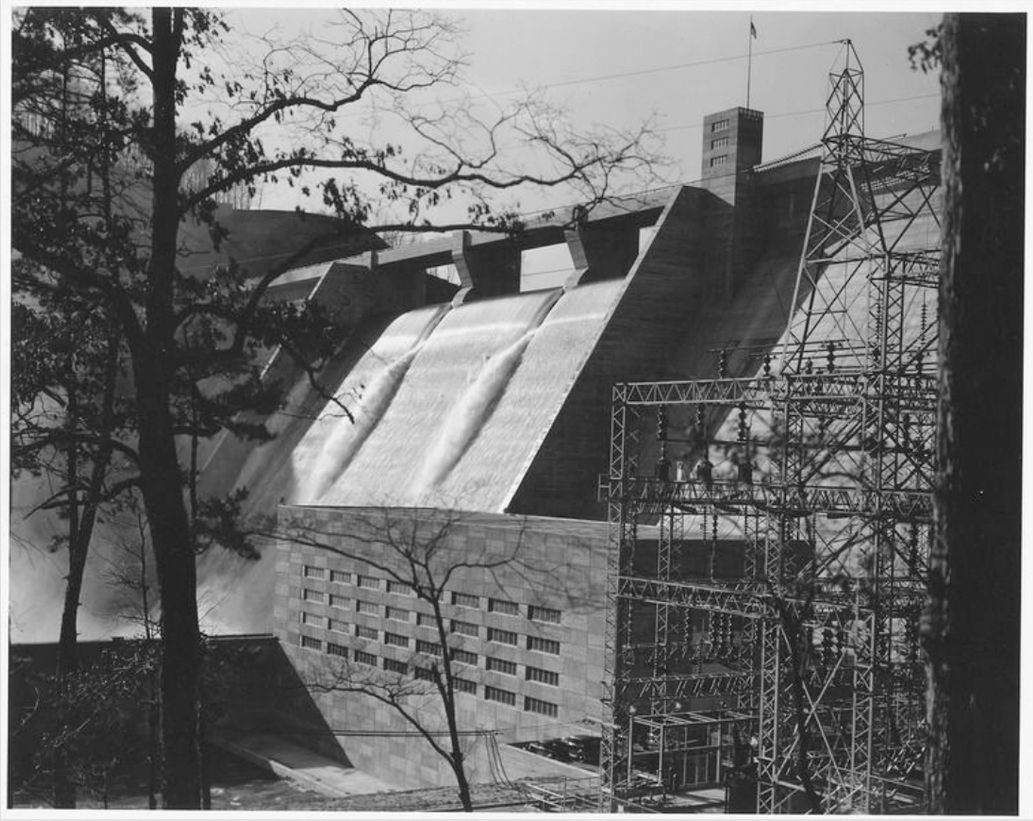
The Castle Gate coal-fired power plant near Helper, Utah, 2007

(Source: David Jolley)

The Hoover Dam when completed in 1936 was both the world's largest electric-power generating station and the world's largest concrete structure.

(Source: Tobi 87)

The hydroelectric Norris Dam, a TVA project, in 1937.



(Source: National Records and Archives Administration)

Typical Brazilian fuel station with a choice of four fuels available: diesel (B3), gasoline (E25), neat hydrous ethanol (E100), and natural gas (CNG). Piracicaba, São Paulo, Brazil

(Source: Mario Roberto Duran Ortiz)

‘The Energy of a Bright Tomorrow’: The Rise of Nuclear Power in Japan

EDITOR’S NOTE:

The devastating earthquake and tsunami in Japan this past March left the Fukushima Daiichi nuclear power plant crippled and the world worrying about the consequences of this nuclear disaster. This month Craig D. Nelson looks at the long relationship the Japanese have had with nuclear power to explore the paradox of how the nation that suffered nuclear destruction in 1945 came to embrace nuclear energy so enthusiastically.

Published June 2011.

By CRAIG NELSON

On March 12, 2011, an explosion rocked the towns of Futaba and Okuma in Fukushima, Japan, but few were there to hear it.

The day before, the earth and then the sea turned against the towns in twin disasters that leveled homes and businesses, strewed debris across lawns and fields, and tore chasms through the asphalt streets. But it was a human-made disaster at the nearby nuclear power plants that made Fukushima residents flee.

Protesters demonstrate against nuclear power and a storage facility at Rokkasho following the March 2011 disaster at Japan's Fukushima I power plant, the worst nuclear disaster since Chernobyl (1986). Coinciding with its efforts to foster economic growth following the Second World War, the Japanese government extolled the safety, modernity, and promise of nuclear power—an image that has been increasingly called into question since the Fukushima accident. (Source: flickr/SandoCap)

Among the few who remained to hear the explosion were those too stubborn to leave their homes and the pet akitas and huskies reluctantly left behind by their fleeing owners. Although the town was mostly abandoned, the

nation and the world saw the blast on television. As subsequent hydrogen explosions ripped through the Fukushima Daiichi nuclear power plant, many watching uttered two words: Chernobyl and Hiroshima.

Few words in the collective vocabulary elicit more fear. Whereas terms like meltdown are abstract, mention of Chernobyl (1986) and Hiroshima (1945) bring to mind human suffering from real events. Happily, neither Hiroshima nor Chernobyl would be replicated at Fukushima Daiichi—prevented by both the reactor designs and the laws of physics.

A 1999 photograph of Fukushima I Nuclear Power Plant. (Source: Flickr by Kawamoto Takuo)

An atomic bomb requires a rapid, uncontrolled chain reaction of fission, but the design of Japan's nuclear reactors precludes such a cataclysmic scenario. The controlled reaction that powered the Fukushima reactors has already stopped, making such concerns moot.

Although the disaster at Fukushima I is the only disaster to share the worst rating on the International Nuclear Events scale, best estimates place the radiation release at 10% of that at Chernobyl. Events at Chernobyl were exacerbated by the lack of a steel containment dome, which all of the reactors at Fukushima have, and a reactor design that allowed the nuclear chain reaction to continue in spite of the loss of coolant.

A sign depicting radioactivity hangs outside a café in the abandoned town of Pripyat near Chernobyl, Ukraine. (Source: VOA Photo / D. Markosian)

Yet, we are haunted by the specter of our nuclear past. And given Japan's complicated past with nuclear issues, it is especially surprising that Japan now has such a highly developed civilian nuclear power program, the third largest in the world after those of the United States and France.

The bombings of Hiroshima and Nagasaki, fallout from the testing of Soviet nuclear weapons, and the Lucky Dragon Incident of 1954 left the Japanese in the 1950s with what some observers have called a "nuclear allergy." Historically, Japanese anti-nuclear-weapons activists have been among the most vigorous in the world.

But the desperate need for energy to power Japan's rapid economic growth and the complexities of post-World War II

international relations together led the Japanese government to pursue nuclear power.

Choosing a nuclear policy was one thing, persuading an initially reluctant public was quite another. The government and electric utilities promoted the nuclear power option relentlessly, starting a public relations campaign in the mid-1950s that strove to cement a positive image of nuclear power in the public eye.

Dogs left by their owners following the March 2011 nuclear disaster roam a street in Futaba in front of a sign that reads 'nuclear power is the energy of a bright tomorrow.' (Source: photo by bubba23)

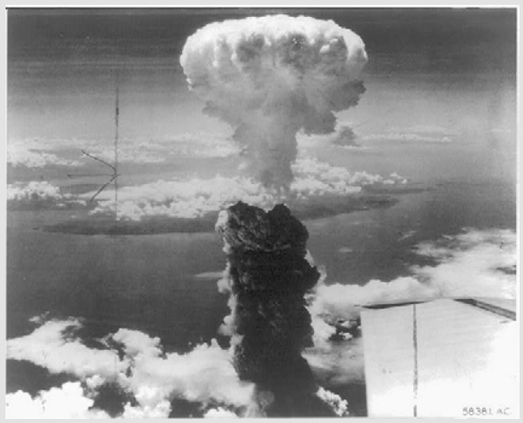
In Futaba, a sign bearing the town's motto—"nuclear power is the energy of a bright tomorrow"—now stands as an eerie reminder of that campaign for a nuclear-powered future.

But nuclear power has remained a sensitive issue and the public has long expressed ambiguous feelings and increasing concern toward it. The government, by contrast, has remained a firm supporter, even in the face of incidents and disaster that gave rise to questions about the wisdom and safety of nuclear power, such as Chernobyl and Three Mile Island (1979).

Regardless of the outcome of the disaster at Fukushima Daiichi, nuclear issues have played a starring role in Japanese politics, society, and culture for the past seventy years—one that is unlikely to disappear in the near future.

From Hiroshima to Atoms for Peace

Like other researchers, Japanese physicists and chemists closely followed the discovery of nuclear fission by Otto Hahn, Fritz Strassmann, and Lise Meitner in 1938. Japan was one of the few countries at the time with the material resources and scientific talent to pursue this research. In fact, Japan embarked on not one, but two research efforts to create an atomic bomb during World War II.



Atomic bombing of Nagasaki, Japan, August 9, 1945. (Source: Library of Congress)

Of course, Japan lost the race, and instead of victory through atoms, two of her cities, Hiroshima and Nagasaki, burned in a nuclear holocaust in 1945.

After the end of the war, however, the United States Occupation banned all nuclear research in Japan, including medical and power applications. Although the end of the Occupation in April 1952

opened the possibility for nuclear research to begin again, it was not until after President Dwight Eisenhower's famous "Atoms for Peace" speech to the United Nations General Assembly that nuclear power research started in earnest in Japan.

A 1955 U.S. postage stamp marking U.S. President Dwight Eisenhower's 'Atoms for Peace' program. (Source: Public Domain)

On December 8, 1953, twelve years to the day after the United States declared war on Japan, Eisenhower laid out a grim future for the world, one dominated by nuclear weapons of ever increasing destructive capability. After first scaring his audience, he pivoted and offered a solution: the development of civilian nuclear power.

The United States, he proposed, would share nuclear technology, train technicians from other countries, and loan fissionable materials for research and commercial power production.

At its heart, the Atoms for Peace program had two purposes. The Eisenhower administration designed the program to foster good relations between America and its allies, and to show the material benefits of allying with the United States. But Atoms For Peace was also a nuclear weapons disarmament program designed to provide an alternative use for the radioisotopes necessary for nuclear weapons.

His approach assumed that the sharing of nuclear technology would foster cooperation and trust between the United States and the Soviet Union. Eventually, the demand for nuclear materials for peaceful purposes would grow to the point when both sides would dismantle weapons to provide fuel for reactors.

Eisenhower's proposal painted a positive future for nuclear power, one that was creative and productive, rather than purely destructive.

Japanese stamp commemorating the completion of its first research reactor. (Source: Public Domain)

As far as the Americans were concerned, Japan had a special place in this proposal. Since Japan had been the victim of the first and only atomic bombings, it would only be fair that Japan be among the first countries to benefit from advances in nuclear power.

Before an offer could be floated, however, a disaster struck in the form of the Lucky Dragon Incident.

Unlucky Dragon

A photograph showing the injuries of Sumiteru Taniguchi, who was injured in the August 9, 1945 atomic bombing of Nagasaki. (Source: photo by Joe O'Donnell, US Marines)

On March 1, 1954, the United States test detonated a hydrogen bomb in the south Pacific, the fallout from which coated a Japanese fishing boat by the name of the Lucky Dragon Number 5 with a thick, radioactive ash. The 23 sailors aboard were covered in the ash and most were coming down with the early stages of radiation sickness by the time they returned to Japan on March 14.

Panic exploded in Japan with the revelation that not only were the fishermen affected by the fallout, but that their catch had already been sold at market before anyone thought to test it. The abstract threat of invisible atomic poison became all too real once people began to realize that it had infiltrated the food supply.

The tragedies of Hiroshima and Nagasaki were still fresh. But it was the Lucky Dragon incident that provided the opportunity for a national discussion of the effects of radiation, which were not particularly well understood immediately after the bombings. Even though studies of Hiroshima and Nagasaki revealed valuable information about the effects of radiation on the human body, this knowledge was not well circulated and the U.S. Occupation censored such information in the press.

In order to calm the anger and fear from the Lucky Dragon incident, the Eisenhower administration offered to establish an agreement to share nuclear technology and radioisotopes with Japan. In the midst of a major scandal over radiation exposure, Japanese politicians quickly accepted.

The Choice for Nuclear Power

Why would Japanese officials accept new nuclear technology in the middle of a crisis that was commonly (if hyperbolically) called "a new Hiroshima"?

It was hardly an auspicious time for a nuclear power program. But, the immediacy of the Lucky Dragon crisis aside, nuclear power appeared to Japanese leaders as the only viable long-term option for the production of sufficient electricity for the country.

In the 1950s, Japan, which had been devastated in the war, embarked on an ambitious economic recovery program that witnessed double-digit economic growth and culminated in the "income doubling plan" of Japan's "Golden Sixties."

The issue of energy scarcity was front and center in the minds of Japanese policy makers during this rebuilding. To meet surging demand for electricity, they had little choice but to turn to new

A photograph of devastation in Hiroshima following the dropping of the atomic bomb in August 1945. (Source: Library of Congress/US Army)

sources or power, which immediately after the war were based primarily on hydroelectricity and coal burning plants.

Hydroelectric plants were attractive because once the dam and turbines are built, the only costs associated with them are largely operational and maintenance. Yet, annual droughts lowered the water levels of many rivers, making electric output variable and regularly causing blackouts during the summer when the water was at its nadir and demand at its zenith. Developing this resource, moreover, could not continue unabated. By the mid-1950s, most of the easily dammed sites had already been developed.

Likewise, Japanese sources of coal were shallow and poor, and had been overexploited during the war. In the 1950s—with traditional sources of imported coal from China blocked because of the civil war and communist victory—high quality coal had to be imported all the way from the east coast of the United States.

In addition to its economic benefits, nuclear technology also provided a symbolic way to rebuild Japanese society after the war. American bombers had physically destroyed Japanese infrastructure, including a large number of coal-fired power plants. World War II had also unraveled Japanese conceptions of their place in the world.

Since the beginning of modernization in 1868, Japan sought first to catch up to the West and then prove that it deserved a place among the world's great powers. Through the Second World War, these efforts hinged on the building of an empire, both for resources and for international prestige.

Japan's loss undid fifty years of development and undermined Japanese identity and its role in international affairs.

After the war, a number of prominent figures proposed the development of science and technology as a method of playing a positive role in the world community.

As early as 1950, Nakasone Yasuhiro, a member of the lower house of the Diet at the time and later Prime Minister, saw nuclear power as an area where Japan could contribute to the world and maybe even make up for Japanese war crimes.

More famously, Prime Minister Yoshida Shigeru proposed what is known as the Yoshida Doctrine. This policy argued that Japan should focus on economic development, fueled by technological development, and eschew playing an active role in international affairs. Nuclear power fit this policy quite well. Many in Japan and throughout the world firmly believed that this technology would bring on a new industrial revolution. Nuclear power would generate electricity that was so cheap that it wouldn't even be worth metering. What better way to rebuild post-war Japan than using the most modern technology that would shape a new era of prosperity? In the 1950s, people had seen the future, and it ran on nuclear power.

Natriumko, mascot for the Power Reactor and Nuclear Fuel Development Corporation. (Source: Wikimedia Commons)

Selling the Nuclear Option

After deciding on nuclear power, the Japanese government, electric utilities, and nuclear industry engaged in extensive efforts to persuade the public to support it.

This was no easy task. A survey by the U.S. Department of State in 1956 found that Japanese were much more pessimistic about the potential civilian applications of nuclear power than Europeans and Americans. In Japan, 39% said that nuclear technology would provide more harm than good in the long run, while 22% said it would be more beneficial than harmful. In Europe and the US, these figures were nearly the reverse.

In order to overcome this reluctance, the government and industry launched a relatively successful public relations campaign.

They sponsored traveling exhibits, lectures, films, and slides that extolled the safety, modernity, and promise of nuclear power. Predictions of nuclear-powered cars and consumer electronics appeared regularly in the newspapers, which ran a spate of pronuclear articles.

Astro Boy. (Source: Dark Horse Comics)

Popular fiction mirrored public fascination with—and growing acceptance of—all things nuclear. One need go no further than Osamu Tezuka's comic, *Tetsuwan Atomu* (literally: Iron-armed Atom), known as *Astro Boy* in the English speaking world. The comic books began their run in 1952 and they depicted a nuclear-powered wonderland –a far cry from the Japan of that time.

Although few of the stories have anything to do with energy sources, the connections to nuclear issues are ubiquitous, starting with the main character's name: Atom. Atom's mentor creates a nuclear family (a pun that works in Japanese as well). His sister is named Uran, which means uranium in Japanese, and his brother is Cobalt, another important element in nuclear physics. Nuclear power would bring a utopian future.

Nuclear weapons are conspicuously absent throughout the run of *Astro Boy*. In this future, nuclear weapons would be replaced by peaceful nuclear power, one of the key aspirations of the Atoms for Peace program.

Opposing Nuclear Arms

Much like in Tezuka's work, the Japanese people's growing support for nuclear power did not extend to nuclear weapons. While there was no shortage of people who opposed nuclear power in the 1950s and early 1960s, nuclear critics tended to focus on the issue of nuclear weapons rather than electric power.

A movie poster for the movie Godzilla first made in reaction to the Lucky Dragon Incident of 1954. (Source: Toho Company Ltd.)

One of the main anti-nuclear groups, *Gensuikyou* (founded in 1955), for instance, opposed both nuclear weapons and power, but their early focus was clearly on weapons.

To protest the testing of nuclear weapons, the Toho Company, Ltd. produced the classic monster movie, *Godzilla* (1954). Director and co-author Ishirou Honda made this film in reaction to the Lucky Dragon Incident and it hit theaters six months after the Lucky Dragon returned home.

Godzilla's origins depend on which of the 28 films you watch. In the first film, Godzilla was a creature from an earlier time that had been reawakened and mutated by American hydrogen bomb tests in the South Pacific.

Bill Tsutsui, renowned scholar of all things Godzilla, notes that Godzilla's scaly skin is reminiscent of the scarring and scabbing of survivors of the atomic bombs of Hiroshima and Nagasaki,

thus heightening the connection to the dangers of radiation from the bombs.

Japanese opposition to nuclear weapons is, of course, understandable given that they remain the only people ever to be the victims of an atomic bombing. Anti-nuclear rhetoric is common at the peace demonstrations that still take place annually on the anniversaries of the bombing of Hiroshima and Nagasaki.

A Japanese anti-nuclear protest in April 2011. (Source: Flickr/ SandoCap)

Notably, opposition to nuclear weapons in Japan was not the position of political outsiders, but was a policy held by the Japanese government.

The constitutional place of the military in Japan made the idea of Japan developing its own nuclear weapons untenable. Article 9 of the post-war Constitution of Japan expressly "renounce[s] war as the sovereign right of the nation" and forbids the maintenance of "land, sea, and air forces as well as other war potential." Although interpretations of this article of the constitution have changed with time, these clauses were read in a very strict sense in the 1950s.

Even Prime Minister Nobusuke Kishi, who argued in 1957 that the development of nuclear weapons was not prohibited by Article 9, believed that it would be best not to develop them for humanitarian reasons.

Prime Minister Eisaku Satou—a staunch supporter of peaceful nuclear power—later developed Japan's famous Three Non-Nuclear Principles in 1964. These principles, which were formally adopted by the Diet in 1967, said that Japan would not possess, manufacture, or allow nuclear weapons on Japanese soil.

Recent revelations have made it clear, however, that the Japanese government did regularly and knowingly allow American naval vessels armed with nuclear weapons to call at their ports. Even though the violation of the policy had happened forty years earlier, public outrage ensued.

The Local Politics of Anti-Nuclear Protest

The nuclear power protest movement started to come into its own in the 1970s, after the construction of the first wave of nuclear reactors was completed. This period coincides with the emergence of environmental issues as a component of Japanese politics.

The national movement grew out of local, not-in-my-backyard (NIMBY) style protests around the sites of the early nuclear plants built in the mid-1960s to the early-1970s. Protests reflected a

range of concerns, from nuclear safety to fears of disruptions in the local economy.

After initially choosing a British-designed, graphite-moderated, gas-cooled reactor for their first commercial plant, the Japanese instead decided to go with boiling water and pressurized water reactors designed by General Electric and Westinghouse. These designs had proven safer and more reliable than those designed in other countries.

The GE models required large amounts of water, however, to serve as both moderator and coolant, which meant that Japanese reactors would need to be placed on the seaside, since there were few rivers suitable to the task in Japan.

Proximity to the ocean, however, raised concerns about the plants' effects on the local fishing industry. Nuclear power plants expose water to the heat produced by nuclear fission, turning it to steam, which then pushes turbines that generate electricity. After the steam condenses back to a liquid state, it is placed in cooling towers that hold the water until it is no longer super-heated.

Many nuclear plants regularly dump this water into nearby bodies of water while it is still several degrees warmer than the water into which it is dispersed. The heated water, though free of radioactive contamination, can kill large numbers of fish, which cannot adapt to the rapid temperature change.

Several towns near nuclear plants experienced large-scale fish population decline, decimating the local economy based on fishing and in turn engendering protest from angry fishermen.

These objections were compounded by the fact that nuclear power plants were typically built in poorer areas and offered few other opportunities for development. In order to attract the plants, towns first tried to outdo one another with perks and subsidies, only later to witness disruptions in their ways of life after the plants were built.

These towns were inundated first with construction workers and then highly specialized, well-paid workers to run the plants, not all of whom were suited to a small, fishing town lifestyle. Such concerns were mostly local in nature, however.

The national anti-nuclear power protest movements began as an attempt to link local groups together and share techniques for postponing or preventing plants from being built.

The *Genshiryoku Siryou Jouhoushitsu* (known in English as the Citizen's Center for Nuclear Information, or CNIC), founded in 1973, was one of the main groups in the creation of a broader movement.

The CNIC's focus remained on supporting local movements, but its members also engaged in a broader effort to alert the Japanese people about the dangers of nuclear power. It published a newsletter, organized and led marches, gave lectures,

produced pamphlets, circulated petitions, and trained regular people to share information with the public.

The movement was broadly successful in preventing new nuclear plants from being built by encouraging locals to oppose the issuance of permits in their areas. But it was not as successful on a national scale and failed to affect policy directly. Japanese media organizations regularly described the protest movement as weak through the 1980s.

Addicted to Atoms

Clean up following the Three Mile Island nuclear accident in 1979. (Source: Library of Congress)

Despite protests from the anti-nuclear movement, the dangers of nuclear power have historically done very little to influence Japanese policymakers.

Accidents at the Three Mile Island Nuclear Generating Station in 1979—in which a partial meltdown of one of the station's reactors led to the release of 43,000 curies of radiation—and the Chernobyl Nuclear Power Plant in 1986—a meltdown that spread radioactive material throughout Europe and the World Health Organization predicts will shorten the lives of 4,000 people—also failed to slow the government's and utilities' plans to develop nuclear power.

The nuclear reactor at Chernobyl. (Source: Flickr/Timm Suess)

Both the Kansai Electric Power Company and Tokyo Electric Power Company began construction on new nuclear reactors in 1980, the year after the incident at Three Mile Island. The construction coincidentally included Fukushima Daiichi Number 4, which was involved in the recent nuclear disaster.

Perhaps this lack of delay is understandable given the ultimately minor damage caused by the partial meltdown at Three Mile Island. But the Shikoku Electric Power Company started construction on a new plant only *three months* after the horrifying complete meltdown at Chernobyl.

All told, Japanese utilities began construction on five nuclear power plants within 14 months of the beginning of the crisis at Chernobyl, while many other countries suspended all new construction for decades.

In part, the Japanese government did not suspend new construction because these reactors had been planned years

before and had already gone through the permitting process. More tellingly, the Japanese Atomic Energy Commission's official response to Chernobyl was a short report explaining that Japanese nuclear power plants' designs were substantively different enough that a similar accident was not possible in Japan.

This point is true enough. But not delaying construction of new reactors to review standards was a singularly remarkable response to an unprecedented disaster. The response was also in line with the Japanese government's unwavering support for nuclear power.

An anti-nuclear protest in Harrisburg, Pennsylvania following the accident at the Three Mile Island Nuclear Generating Station, 1979. (Source: National Archives)

Following the events of Chernobyl, the anti-nuclear power movement gained a fleeting national presence. Groups like the Citizen's Nuclear Information Center organized marches that mobilized tens of thousands of people in Tokyo on the first anniversary of the meltdown at Chernobyl. Fear of radioactive contamination of food imported from Europe mobilized many people. The CNIC noted that many of the protestors were women worried about their children's future in light of the dangers inherent in nuclear power.

While this boost in interest did not last all that long—with marches on subsequent anniversaries receiving smaller and smaller attendance—the months after Chernobyl did mark a notable shift in public opinion. For the first time in decades, more Japanese disapproved of nuclear power than approved.

Public approval for nuclear power remained volatile throughout the 1990s as a number of scandals tarnished the program's image, including the government cover-up of the extent of the damage caused by a sodium fire at the experimental Monju power station in 1995 and the radiation exposure caused by the Tokaimura criticality incident in 1999.

It is worth noting that new nuclear power reactor construction did not stop even in periods of popular opposition. Since construction on the first commercial reactor began in 1960, there has not been a single year when a nuclear reactor was not under construction somewhere in Japan.

The Way Forward

As of the writing of this article, there remains serious damage to units 1-4 of the Fukushima I power plant. During the days after the earthquake and tsunami, hydrogen explosions severely compromised the containment buildings of at least two of the

Tsunami damage in Fukushima Prefecture following the March 11, 2011 twin disasters. (Source: Flickr/Jun Teramoto)

A satellite image showing damage to the Fukushima I Nuclear Power plant. (Source: DigitalGlobe-Imagery)

reactors, resulting in periodic releases of radioactive steam and irradiated water.

Although electricity has been restored to units 1-4, engineers are still having difficulty keeping the fuel submerged to prevent the fuel rods from melting. High radiation levels are making any amelioration work and monitoring of the situation very difficult.

Tokyo Electric Power Company has not released official figures for the amount of radiation released as a result of the disaster, but estimates place it at only a fraction of the amount released during the incident at Chernobyl. Only time will tell the full impact of Japan's nuclear tragedy.

All of this leaves two related questions: why have the Japanese people continued to support nuclear power and what will happen to the nuclear power program in light of recent events?

Even disregarding the recent catastrophe, many of the reasons that the Japanese people accepted nuclear power to begin with may no longer hold true. Nuclear power never realized its perceived potential to change the world with nearly free power, and few around the world look to it any more as a pure expression of the future any more.

Japan managed successfully to rebuild after the war, though it has remained mired in a long recession since the 1990s. Japanese identity and Japan's place in the world are still

influenced by science to a large degree and many take pride that Japan leads the world in nuclear technology. But there are other technologies that Japan leads in—like robotics—so the loss of leadership in nuclear power would not be a devastating psychological blow.

The government, the utilities, and the nuclear industry have spent the last half century promoting nuclear power as safe, futuristic, and, more recently in the past 25 years, environmentally friendly. Proponents note that it is the one source of energy that does not produce carbon dioxide. The hype turns nuclear power into a miracle of science that makes modern life possible.

A sign at a March 2011 protest in Germany gives the dates of accidents at the Three Mile Island, Chernobyl, and Fukushima nuclear power plants and states: 'Now, let's draw the lessons.' (Source: Flickr/cephir)

With the disaster at Fukushima, Japanese people will almost certainly reexamine this marketing narrative, especially the issues of safety and environmental impact.

It is hard to talk about safety when there is a 30-kilometer evacuation zone. Radioisotopes in the drinking water do not make people think of the technology as environmentally friendly.

Doubtlessly, there will be a rigorous debate about which way Japan's energy policy should go, but the primary question remains: what is the alternative?

Nuclear power provides about 30% of all electric power in Japan today, and it could be years before this portion could be replaced with another form of power.

Even then, what type should it be? Coal and oil provide much of the energy in the world, but they are expensive to import to Japan and are arguably no safer or environmentally friendlier than nuclear power.

Consider this: the partial meltdown of one of the reactors at Three Mile Island released 43,000 curies of radiation into the surrounding area. Studies have not proven a link between this radiation exposure and a single death.

Meanwhile, in the same year, coal power plants operating in the United States alone released 6.6 million curies of radiation as part of their standard operation. Further, a Clean Air Task Force study found that air pollution from coal powered plants kills around 13,000 people every year in the United States, while the Environmental Protection Agency (EPA) estimates that 22,000

American lives are shortened every year by the effects of coal pollution.

Other forms of power generation are cleaner, but each has generated its own controversies: photovoltaic cells remain expensive and cannot be used at night; many people consider windmills to be a nuisance, they are known to kill birds, and have a high upfront cost; and hydroelectric dams damage river ecosystems and the most accessible rivers in Japan have already been dammed. With time and innovation, many of these problems might be overcome, but not immediately.

Even if the Japanese government decided to shut off all nuclear power plants tomorrow—which it will not do—there is still the issue of disposing of the waste, an issue that has yet to be dealt with in Japan (just like in the United States). The long-term storage facility at Rokkasho should be ready to open in the next several years but delays have plagued the plant since its conception, and rigorous protests over its siting are ongoing.

The lack of place to store spent fuel rods compounded the problem at Fukushima. In Japan, as in the United States, used fuel rods are stored at the plants in pools that require a steady supply of water to replace that lost to evaporation. The spent fuel pools at Fukushima lost coolant and began to melt, thus releasing even more radioisotopes into the atmosphere.

If there had been a long term storage space available, the loss of coolant to the spent fuel pools would have been a minor problem, rather than a catastrophe that threatened the containment of over 11,000 fuel rods, more fuel than the reactors themselves contained.

The decision to stop building new reactors could create the illusion of safety; the idea that the nuclear problem had been dealt with. Yet, the decision to suspend construction of new plants is meaningless without a full review of the safety of existing plants.

Part of the problem at Fukushima resulted from a lack of planning for a tsunami following an earthquake, with seawalls that were too low and backup generators placed in low-lying areas. These types of problems are likely present in many Japanese nuclear plants, particularly the older ones (like the Fukushima reactors).

The future of the Japanese nuclear power program will hinge on the reaction of the Japanese people. If the reality of the disaster outweighs the benefits of the plants for a large portion of the public, the pace of new construction could stop or further slow. If, however, the benefits are considered to outweigh the risks, Japan may yet continue to be a leader in nuclear power development.

In all likelihood, the Japanese government and utilities will continue selling nuclear power indefinitely. The only question is whether the Japanese people are still going to buy it. ◆

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Maps and Charts

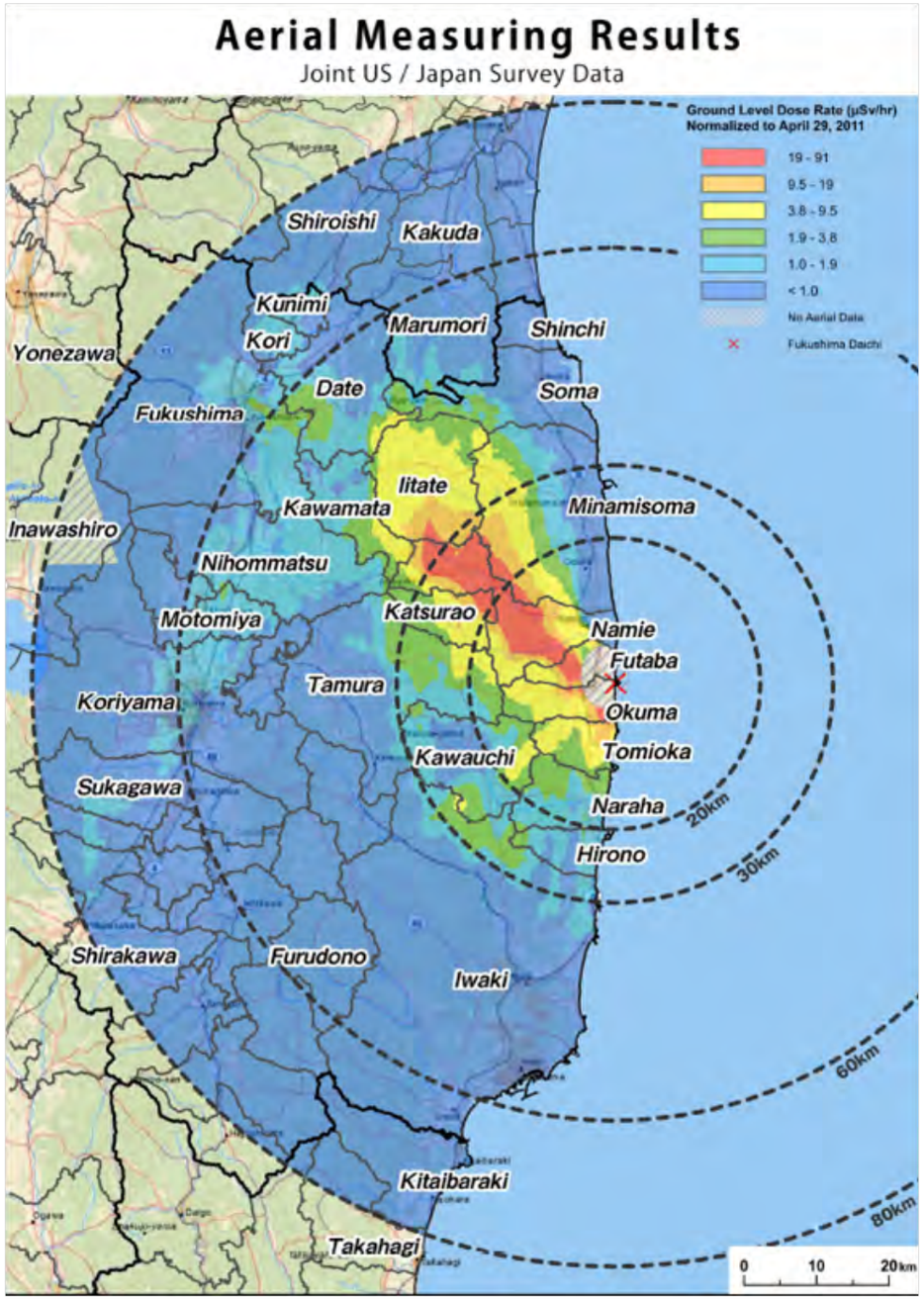
A map showing Japan's nuclear power plants

(Source: International Nuclear Safety Center at Argonne National Laboratory)

A map showing Japanese nuclear power plants and highlighting the areas most severely affected by the March 11, 2011 twin disasters

(Source: Wikimedia Commons)

Radiation levels near the Fukushima Daiichi nuclear power station as of May 6, 2011



(Source:Joint United States-Japan survey data provided by the U.S. Department of Energy, National Nuclear Security Administration (NNSA), Office of Emergency Response)

An orthographic projection of Japan

(Source: Wikimedia Commons)

Additional Images

A 1975 aerial view of the Fukushima I Nuclear Power Plant. Reactors 4, 3, 2 and 1 appear at the bottom. Reactor 5 and the construction site for reactor 6 are in the upper part of the photograph.

(Source: Japan Ministry of Land, Infrastructure and Transport)

A Japanese anti-nuclear protest in April 2011

(Source: Flickr by SandoCap)

Tsunami damage in Fukushima Prefecture following the March 11, 2011 twin disasters

(Source: Flickr by Jun Teramoto)

Cenotaph and Atomic Bomb Dome, Peace Memorial Park, Hiroshima, Japan

(Source: Wikipedia Commons)

Section 3

Hiroshima

By CRAIG NELSON

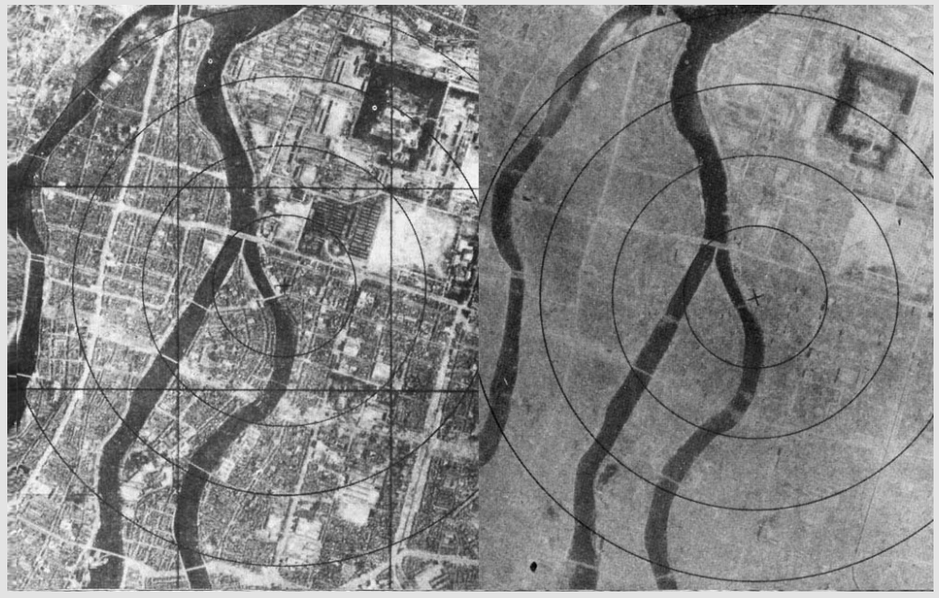
Published August 2015.

The atomic age began between heartbeats at 8:15 am on August 6, 1945 when the Japanese city of Hiroshima was leveled by an atomic bomb. Three days later, the United States dropped a second bomb on Nagasaki. This month marks the 70th anniversary of when humanity first broke atoms in anger.

For the people of Hiroshima, the day was one of unimaginable suffering. The blast killed 80,000 instantly, and over 100,000 additional people would later succumb to their injuries, perish in the conflagration that consumed the city, or die from the radiation that fell darkly to the earth in a “black rain.”

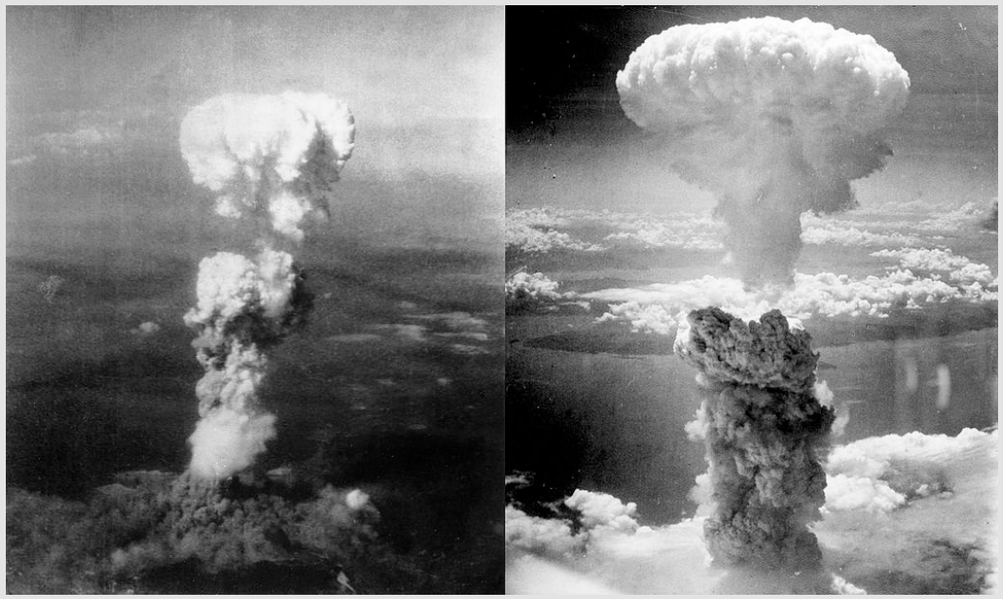
The situation was made worse because the Americans had not previously bombed Hiroshima with conventional weapons; despite the fact that it was a major military base and was designated to be the new capital should Tokyo fall into enemy hands. The absence of bombing had convinced tens of thousands to seek refuge in the city's illusory safety, unintentionally adding to the death toll.

Aerial view of Hiroshima before and then after the bombing.



(Source: Wikipedia)

The destruction of Hiroshima marked the culmination of the aerial campaigns of World War II. Although Western Europe and the United States decried Nazi support of the bombings of civilian targets in the Spanish Civil War and Japanese attacks on Nanjing and Guangzhou less than a decade earlier, the Allies had fully embraced strategic bombings of civilians by 1945.



The dropping of the bombs over Hiroshima (left) and Nagasaki (right) resulted in towering mushroom clouds. (Source: Wikipedia)

By the end of the war, the Allied bombing campaigns had left dozens of Japanese and German cities in ruins. The American firebombing of Tokyo caused much of the city to burn down and killed between 75,000 and 200,000 people. Similar Allied attacks in Germany killed upwards of 46,000 in Hamburg and 25,000 in Dresden.

Although the Japanese people suffered greatly during this bombing campaign, their country was hardly an innocent victim of the war. It was an aggressor that invaded countries throughout Asia and treated them brutally.

The terror its citizens experienced through the American bombing campaign was itself a mirror of that experienced by the victims of Japanese invasions throughout Asia. It should not be forgotten that among the dead in Hiroshima were twenty thousand Koreans who the Japanese had forced into slave labor.

This structure was one of the few left standing after the bombing in Hiroshima. It is now known as the Atomic Bomb Dome. (Source: Wikipedia)

Japan was also a full participant in the international race to develop nuclear weapons and would doubtlessly have used those same weapons had it succeeded in developing them. In fact, Japan only abandoned its efforts to build atomic bombs after a series of shortcomings and failures convinced its government to focus on a different super weapon program: a death ray that would have used microwaves to kill.

Hiroshima in the wake of the bombing. (Source: Wikipedia)

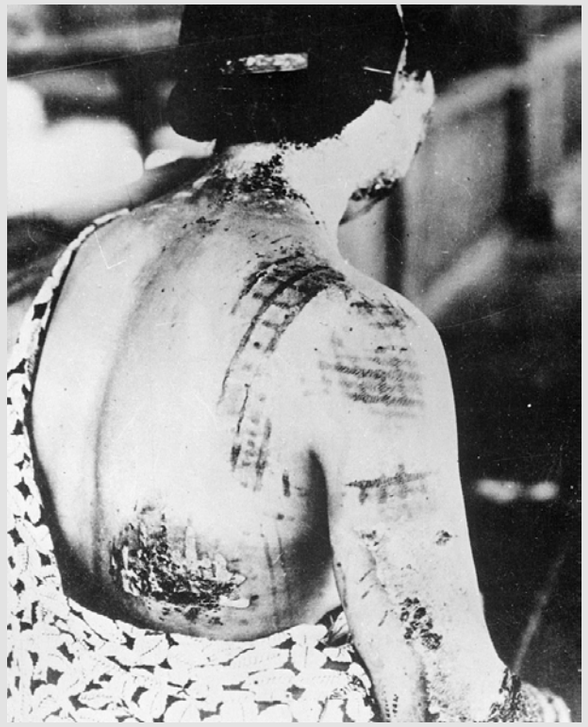
President Harry S. Truman ordered the bombing of Hiroshima with the belief that it would shorten the war and save lives, though he was predominantly focused on American lives. His commanders predicted upwards of half a million American casualties if a direct assault on Japan was necessary and even higher numbers of Japanese.

The American leadership also considered a swift end of the war in the Pacific necessary because the Soviet Union was set to enter the war against Japan on August 8, 1945, three months to the day after the defeat of Germany. Truman and other American leaders pushed to end the war before the Soviets could earn a zone of occupation in Japan as they had in Germany.

A view of the Atomic Bomb Dome today from the Hiroshima Peace Memorial Park. (Source: Wikipedia)

To this day, scholars hotly debate whether the bombings of Hiroshima and Nagasaki or the Soviet entry into the war brought the war in the Pacific to a close, but, as Japanese officials observed at the time, it was a combination of both.

The Japanese strategy, however, was incompatible with the Americans' haste to end the war. Most Japanese leaders recognized that their cause was lost in 1945, but hoped to force a decisive battle that would leave them in a position to surrender while maintaining their government. Over and over the Japanese fought desperate battles not to win the war, but to win a seat at the negotiating table.



This woman's burns resulted from exposure to thermal radiation, a by-product of the blast at Hiroshima. *(Source: Wikipedia)*

The Allies held to their demand for unconditional surrender, which was intended to avoid the repeat of the ”stab in the back” myth that emerged in Germany after the end of World War I. Regardless of its purpose, this demand did not give the Allies any flexibility to negotiate with the Japanese.

Despite utter devastation, the effects of the atomic bomb on Hiroshima were not as severe as one might think. Unlike in the nuclear disasters at Chernobyl and Fukushima, the city was never evacuated, though that was largely due to a lack of information and the logistical near impossibility of doing so.

The Americans detonated the Hiroshima bomb nearly 2,000 feet above the city, which somewhat limited the damaged caused by radiation. In fact, in his memo predicting the effects of the bomb, Manhattan Project lead scientist Robert Oppenheimer argued that the radioactive byproducts would go into the upper atmosphere and be dispersed throughout the world.

This process did occur, but the detonation caused a rainstorm that brought many radioactive byproducts back to earth. This “black rain” exposed the survivors of Hiroshima to radiation that caused a host of health problems, such as damage to internal organs and an increased rate of cancer. The black rain would have been hard for Oppenheimer and others who developed the atomic bomb to predict, however, because the only test

This historic torii welcomes visitors to Istukushima Shrine which is both a UNESCO "World Heritage Site" and less than 30 kilometers from downtown Hiroshima. It was untouched by the blast. *(Source: Wikipedia)*

Gracing one of Tokyo's largest subway stations (Shibuya Station), this mural "The Myth of Tomorrow" presents a chilling take on the concept of progress. (Source: Flickr by 305 Seahill)

detonation was done in the Nevada desert where there was not enough moisture for rain.

Hiroshima is indelibly linked with its destruction, but the city and its people are also intimately connected with the peace movement. During their Occupation, the Americans wrote a new constitution for the Japanese, which included the famous Article 9, a provision that all but makes war illegal.

Hiroshima emerged as the spiritual center of both the Japanese antinuclear and peace movements. In the aftermath of the war, it constructed the Hiroshima Peace Memorial Museum that has been dedicated to commemorating the bombing of Hiroshima and to eliminating nuclear weapons. The museum is housed in the Peace Memorial Park, which includes an eternal flame that will burn until all nuclear weapons are eliminated. The Park serves as a gathering ground for tens of thousands to commemorate the bombing and demonstrate for peace.

Today, the Hiroshima's level of radioactivity has reverted to the world background level. The residents of Denver, Colorado experience a higher level of radioactivity than those of Hiroshima and Nagasaki. The residents of Hiroshima report elevated levels of some cancers, with the highest rate of liver cancer in the world, but other forms of cancer occur at average or even low rates comparably.

Hiroshima is an exquisite, complicated city known for its food, the stunning natural beauty of its bay, and an incident 70 years ago that will forever connect it with nuclear weapons and peace. ◆

Chapter 4

Conservation, Wilderness, and Environmentalism

A geyser erupts in Black Sand Basin at Yellowstone National Park.
(Source: Wikimedia Commons, by Broken Inaglory)

Washed Ashore: Marine Mammals from Medieval Times to Today

By ELLEN F. ARNOLD

Published March 2016.

Stranded pilot whales. (Source: New Zealand Department of Conservation)

On 13 February 2015, 198 pilot whales stranded in Golden Bay on the northern coast of New Zealand's South Island. Hundreds of volunteers were mobilized by New Zealand's Conservation Agency, racing against time and tides to save the lives of the stranded whales. Despite the efforts of the Department of Conservation and New Zealand's Project Jonah, 78 whales restranded the following day, and at least 100 died.

Although the exact cause of the stranding remains unknown, the response to the death of the whales may be a unique approach, highlighting the intersection of religion and conservation efforts. The dead whales were given a *karakia* (a ceremonial prayer) by a local religious leader, and tied to ropes and anchors off the bay, left to decompose within the ecosystem.

Europeans who lived in the Middle Ages responded to mass stranding events (MSEs) in their own religious ways but their treatment of the beached mammals was very different. In the year 674, St. Philibert founded the monastery of Noirmoutier on an Atlantic island off the coast of France that still bears its name. At some point in the following decade (he died in 684), a group of 237 porpoises was involved in a mass stranding event nearby.

This event is recorded in the 7th-century biography of the saint, the *vita Filiberti*, or "Life of St. Philibert." This event most likely occurred in the tidal estuary of the mouth of the Loire and is perhaps the earliest recorded mass

Map of the Ile de Noirmoutier. (Source: Wikipedia)

stranding event in the Bay of Biscay or even on the Atlantic coast.

The story of the stranding event is short, and can be given in full:

“And at another time, when a great famine had begun to constrain the territory of Poitiers, and the man of God [St. Philibert], mindful of the needs of the brothers, lay himself down, praying. And when he rose, a great multitude of the fish that are called marsuppas (harbor porpoises) found themselves in the river. When the sea receded, two hundred and thirty seven of them remained on the dry banks. From that point and for the space of an entire year, the brothers had a huge increase in their comfort, and many monasteries and paupers had food aid.”

The medieval actors who encountered and interpreted this stranding understood its causes in multiple ways—some of which resonate with our own scientific understandings and some of which seem more alien to us.

Framed as a miracle story, this account demonstrates the medieval belief that the natural world could be an agent of divine will, supporting the pious who were loved by God.

The aftermath of this medieval event lets us compare modern attitudes towards marine life to pre-modern ones, especially in a shared concern for scarcity and abundance. A deeper awareness of the complexity of past views of nature can help us deal with our own relationship to the fragility and finitude of marine ecosystems.

Patterns of Atlantic MSEs

If the medieval description of a stranding of 237 animals is at all close to the actual number, this would not only be a very early account of an MSE, but it would also be among the largest single MSEs ever recorded in Atlantic or North Sea waters.

For decades, stranding networks across Europe have tracked individual and mass cetacean strandings. In June of 2008, 26 dolphins died in a MSE in Falmouth Bay; before that the largest MSE in English waters had been the 1938 stranding of 15 animals. One of the largest European events in recent years was

These false killer whales were part of an MSE in Flinders Bay, Australia, July of 1986. (Source: Wikimedia Commons)

the stranding of 100 common dolphins at Pleubian on the coast of Brittany in 2002, though only 53 animals died.

(Viral outbreaks—such as the deaths 877 dolphins in Peru in 2012—have claimed much greater numbers of dolphins, but such events usually take place over hundreds of miles of coastline and differ from the kind of single-event beaching described by the medieval source.)

There have been many causes suggested to explain MSEs, ranging from sickness of the animals to unusual climate factors to sonic disruptions. One other commonly suggested cause is that the animals get trapped by changing tides, especially in strong tidal rivers and at sites where beaches, sand bars, and other topographic features might confuse the animals' navigational abilities. The mouth of the Loire may have presented a "stranding beach" likely to trap passing schools of dolphins.

The French stranding network has kept records of beached mammals and seabirds from the 1970s through today. Their data estimates that in the two decades from 1990-2009, 11-20 stranding events (often of only 1-2 animals) occurred per kilometer of coastline around Noirmoutier.

Thus the large number of stranded porpoises in the *vita Filiberti* is startling. Yet, when numbers in medieval accounts are exaggerated, it is usually to round numbers (and often has to do with military accounts) or to symbolic numbers, neither of which 237 is. The precision of this number is suggestive of an attempt to realistically portray and record a remembered event of real significance.

Marine Mammal Life in Medieval Times

We know of many medieval accounts of the beachings of individual cetaceans, as well as the active hunting of whales and dolphins. Historian Vicki Szabo has convincingly described that whales and porpoises were in fact deliberately hunted during the Middle Ages, but beachings were still the most common way that medieval communities encountered large marine life.

She also points out that, while we know very little about of the population sizes of medieval cetacean communities, it is probable that populations were higher than today, and that "more whales also may have stranded in an age of larger whale populations."

Yet when we are able to consult medieval sources, it seems strandings were still infrequent and involved small numbers of animals.

Records from 1379-1479 show only 22 stranded porpoises, and a manor belonging to Battle Abbey near the English Channel only reported 4 stranded porpoises between 1482 and1535. Even taking into account a larger medieval porpoise population, all evidence suggests that the event in 674 would have been a strikingly large and significant one.

In 1577, Flemish artist Jan Wierix engraved Three Beached Whales, which depicts three stranded sperm whales. (Source: Wikimedia Commons)

The 237 stranded porpoises at Noirmoutier would have seemed miraculous both for the number of animals stranded at once and for the timing of the event.

At that time, Noirmoutier was a young and tenuous community still working to establish itself. Philibert founded it while he was in temporary political exile from his position as abbot of Jumieges in Normandy. Though the island was at an important strategic point in trade routes and benefited from the established salt trade, the fragile community appears to have suffered frequent shortages.

In the medieval world, cetaceans and large fish supported human economies and diets. Their meat could be preserved and eaten (and as an added boon, as fish, could be eaten during Lent and on feast days); their oil could be melted down and used in lamps; their bones were used for tools, as building materials, and in art objects. An English abbey included ten porpoises in its preparations for a feast during the 13th century—yet this seeming abundance is rare. A more common yield might be like that of the fishermen of Kent whose catches "rarely exceed[ed] two a year."

Olaus Magnus, a sixteenth-century author, provides evidence for the treasure of resources that a single stranded whale could provide: "When sea-monsters or whales have been hauled out of the sea…the people of the neighborhood divide the booty…in such a way that with the meat, blubber, and bones of a single whale or monster they can fill between 250 and 300 carts. After they have put the meat and fat into vast numbers of large barrels, they preserve it in salt, as they do other huge sea-fish."

Further evidence of the utility of such carcasses is found in the *Canons of Adomnan*, a set of dietary laws collected in 7th/8th century Ireland. The first canon deals with what was a rare exception to a ban on the eating of carrion: "Marine animals cast upon the shores, the nature of whose death we do not know, are to be taken for food in good faith, unless they are decomposed."

The Human Culture of Whales

In the miracle story, the unexpected provision of large marine life was interpreted as an omen of prosperity, as a sign that God

The restored image of Hendrick van Anthonissen's View of Scheveningen Sands revealed the beached whale that attracted the sea-goers. (Source: Wikimedia Commons)

supported Philibert and his monks in their establishment of the island community.

Pre-modern artists in Europe and America were drawn to whales because of their symbolic *and* economic value. Engravings and paintings show a fascination for the dead and dying leviathans and a kind of boisterous celebration. This is exemplified in Jan Saenredam's "Stranded Whale near Beverwyck" (1602) in which crowds of onlookers flock around the stranded giant (whose dimensions are recorded), climbing on it, celebrating it, drawing it, staring at it—it is a town holiday.

Yet over time, these representations changed. Many modern artists shy away from glorifying whale death—the stranded whale becomes a symbol of impotence (of nature, and of people to save nature), of nature "out of place" and something to be pitied and mourned.

An example that I find particularly resonant of this is Adrián Villar Rojas's 2009 work, "My Dead Family" which was part of the "the 2nd Biennial of the End of the World" in Argentina.

A recently publicized example of the transformation of whales in art is Hendrick van Anthonissen's "View of Scheveningen Sands," (ca. 1641), which was recently restored to reveal a beached whale as object of fascination for the Dutch sea-goers. At some point in the 18th or 19th century, a painter covered over the whale with a

"Stranded Whale near Beyerwyck" (Source: Wikimedia Commons)

During yet another incident in 2005, volunteers at Farewell Spit, New Zealand attempt to keep up the body temperatures of beached pilot whales. (Source: Wikimedia Commons)

bland ocean scene with a sailing ship, the crowd's interest oddly inexplicable.

The scope of the "revision" of the painting caught the attention of the media, but is also clearly of interest to environmental historians, as the literal erasure of the whale is evidence for changing cultural ideas about the meaning of these beachings. As commercial whaling increased and modernized, perhaps the sight of a dead whale became both less unusual and less appealing.

Marine Mammals in Recent Times

Our modern responses to cetacean strandings are vastly different than those of medieval Europeans. In the eighth century, the beaching of a single whale or, in this case, a large group of porpoises, would have been met with celebration, and often a group effort to butcher and preserve the animals.

Today, such an event would also be met with communal labor, but directed (generally) first towards the salvation of the animals, and then towards the investigation of causes of death. Instead of being killed and processed (either for food or for fat), whales and dolphins are helped back out to sea if still living, nursed by concerned humans if dying, and either disposed of (through burial, towing to sea and sinking and/or exploding, burning, etc.) or exhaustively necropsied by scientists.

Inuits continue to "hunt" or "cull" whales in Alaska in traditional boats, much like the one pictured here. (Source: Wikipedia)

Indeed, one recent stranding that was treated as a resource in the traditional sense is now held up as a cautionary tale (and the subject of medical and laboratory inquiry). In 2012 a group of Alaskan Inuit consumed a stranded beluga and contracted botulism.

Today, moral, public health, and scientific concerns transform stranded cetaceans from resource into warning. Beachings are carefully and dutifully recorded by teams of activists who race to save stranded mammals—and when MSEs are encountered, they are treated as clarion calls to ocean conservation. (See, for example, the NOAA discussion here.)

Trapped whales convey a sense of nature out of place. The death of a beached cetacean even potentially leads to communal grief and sadness (as in the case famously described by Farley Mowat in *A Whale for the Killing*, in which the Canadian government eventually found it necessary to issue a formal statement of mourning for the stranded fin whale).

Far from being seen as economic boons, beached cetacea are now economic burdens. A BBC article reports that in 2006, a sperm whale had beached live and died on shore in a remote part of Scotland. Its removal and cremation and disinfection of the beach cost 50,000 GBP. The article points to other disposals of cetaceans as having run to 10,000 and 12,000 GBP.

North American coasts have also experienced MSEs, such as this school of black-fish stranded in 1902 on the beach of Cape Cod. (Source: Wikipedia)

Finally, today's whale bodies become fodder not for human sustenance, but for intellectual inquiry through increasingly exhaustive scientific examination.

The marine mammal stranding network explains to the public that the necropsies assist conservation efforts: "In the past few years, increased efforts in examining carcasses and live stranded animals has increased our knowledge of mortality rates and causes, allowing us to better understand population threats and pressures." (See this NOAA site) Their bodies often do not return to the food chain (unlike, for instance, the phenomenon of the "whale fall" in which whale carcasses become benthic ecosystems).

In North America, Inuit practices are occasionally brought into the discussion as well, but in different ways that emphasize the idea of whales as cultural artifacts, and often in ways that question and critique traditional resource economies.

For example, in 2008, a decision by Inuit leaders to cull almost 600 narwhals led to protests. Tensions can be seen between ideas of whales as resource and whales as scientific object, as the "hunt" or "cull" (the term seems to have been contested in media coverage) produced not only animals that were harvested for meat but also "specimens" that were tagged and tissue samples taken.Similar tensions are at play in the Faroe Islands' whale cull, where conservationists have now enlisted the help of filmmaker David Attenborough in their efforts to stop the traditional cull.

From the Medieval to the Modern

At first, it seems that the modern and pre-modern responses to beached marine mammals could not be further apart. Whereas for millennia, humans have turned the death of the animal into a resource and incorporated it into human survival and sustenance, today it may appear that we "waste" the dead and dying animals.

Yet beneath the striking surface differences, a common concern emerges. The scavenging, salvaging, and storage of blubber, meat, and bones in the pre-modern world was of course an economic response to a natural boon—but it was a response that was based on a fear of scarcity. Abundance could be rare and fleeting, as the context of famine in Noirmoutier demonstrates. God could both reward piety *and* warn about scarcity with abundance through the saints and the natural resources they provided in excess.

In the modern world, we are also deeply concerned with scarcity and abundance—through the lens of science, we count beached porpoises as a kind of a measure of and a talisman against our fears about marine scarcity. These efforts, part of a larger global conservation movement, use advocacy programs to call attention to the dead mammals in the hope that new kinds of environmental piety might provide renewed marine abundance.

As conservationists look for more effective and resonant ways to invoke action aimed at the preservation of marine resources, they may find useful ideas in the actions and ethics of the pre-modern world, and in the deeper history of Christianity.

Last summer, Pope Francis, who named himself after a medieval saint closely associated with environmentalism, issued an encyclical on climate change. Evangelical and Anglican leaders in America have already begun to reframe climate change as a religious and moral concern. In the quest to win converts to marine conservation, stepping beyond a modern understanding of marine life, and beyond a restricted (and negative) view of Christianity and ecology may help yield, as it were, a greater catch. ◆

Section 2

Dian Fossey: Conservationist in the Mist

By ROB SCHUBERT

Published December 2015.

In the 1960s, famed paleontologist Louis Leakey challenged the historically male face of primatology by sponsoring the field research of Dian Fossey, Jane Goodall and Birute Galdikas – three women who would become affectionately known as the "trimates."

Fossey's observations of the reclusive mountain gorilla in Rwanda were detailed in her popular book *Gorillas in the Mist* and she worked tirelessly throughout her career to personalize this poorly known animal for people around the world. Through visual references and careful description of behavior, Fossey replaced a fallacious stereotype of a King Kong-like, violent gorilla with an almost idealized image of a gorilla that was intelligent, family-oriented and peaceful.

1984 Photograph of Dian Fossey by Yann Arthus-Bertrand. (Source: Wikipedia)

Thirty years ago this month Fossey was murdered in her field station while she slept. The lack of theft and the brutal nature of the murder, reportedly inflicted by machete, suggested a range of possible suspects including disgruntled employees, vengeful poachers and angry locals. Her murder remains unsolved.

She and her work were not uncontroversial. Throughout my undergraduate and graduate training in Anthropology, if Fossey was mentioned at all it was only briefly, and the professor quickly moved on to the less controversial Jane Goodall. Much as one might discuss a relative with an unsavory past, Fossey's reputation and fame always seemed tainted by something inappropriate.

Shortly after her murder, Montgomery Brower wrote of Fossey in *People* magazine (February 17, 1986): "Fossey, it appears, was no saint. Though she had boundless patience and affection for

Dian Fossey with mountain gorilla.(Source: Celebritiesgalore.com)

the gorillas, she was by temperament and conviction often at odds with people."

Two different stories about Fossey have emerged: One describes her as a loner who was disgusted with humanity and who belittled her fellow workers, orchestrated violent tortures of poachers, performed witchcraft on political enemies and even kidnapped the children of those that threatened "her" gorillas.

The other portrays Fossey as an everyday person inspired to fight for animal rights and willing to put her life on the line to confront powerful government officials, local tribal leadership and poachers.

This latter image is reinforced by Sigourney Weaver's portrayal of Fossey in the 1988 film also titled *Gorillas in the Mist.* Hal Hinson of the *Washington Post* (September 23, 1988) noted of the film upon its release that Weaver's Fossey created something of a caricature of the woman driven by "misdirected maternal impulses" and by a "love for her animal babies."

Much of Fossey's legacy lies in her controversial approach to conservation. Fossey was an ardent proponent of "active conservation" which promoted aggressive, in-person defense of threatened species rather than the creation of new local laws or the development of long-term conservation strategies.

Her conservation philosophy suggests an inherent conflict between native human communities living near primates and conservationists who often come from wealthy, developed countries. Fossey lived this philosophy while confronting government officials, cutting poacher's nets, poisoning hunting

Boabeng-Fiema Monkey Sanctuary, Ghana: Site of the author's research and a growing ecotourism enterprise featuring locally guided tours and close-up observation of two wild primate species: Lowe's Guenon and the Ursine Colobus. (Source: photo by author)

dogs and encouraging her gorillas' fear of black Africans whom she reasoned were the most likely to be poachers.

This conflict mentality has rightly been pushed to the periphery of mainstream conservation as it places the conservationist in a paternalistic role, likely to be viewed as oppressive by local communities.

Nearly continuous research spearheaded through the University of Calgary at my former field site in Ghana, West Africa, for example, has demonstrated that working with, rather than against, local communities is a more productive approach to conservation.

At this site, a coalition between the local community, national wildlife representatives and international researchers (stakeholders with sometimes contrasting goals) has helped to build a growing ecotourism venture that works to strengthen already existing local affinities with the primates.

Much like Goodall, Fossey has also been criticized for anthropomorphizing her study subjects. From creating gorilla cemeteries to the well-documented maternal role she took on for a young male gorilla named "Digit," it is clear that Fossey developed strong emotional connections to her research subjects. This violation of scientific objectivity has rightfully forced researchers to question how we should describe the animals we study and how emotionally invested we should become in their lives.

However, when Walter Kronkite announced the murder of Digit by poachers on the CBS Evening News, it was our ability to empathize with the gorilla—a product of Fossey's work popularizing his life—that led to an international outpouring of grief, the creation of the Digit Fund to protect gorillas, and a heightened awareness of the mountain gorilla's conservation status.

2010 Photograph of Cecil the lion at Hwange National Park. (Source: Wikipedia)

Had we not gotten to know Digit as an individual personality, even if it was artificially constructed, would we have cared about his or any gorilla's loss? One cannot help but see parallels with the world's reaction to the recent killing of Cecil the lion in Zimbabwe by a Minnesota dentist.

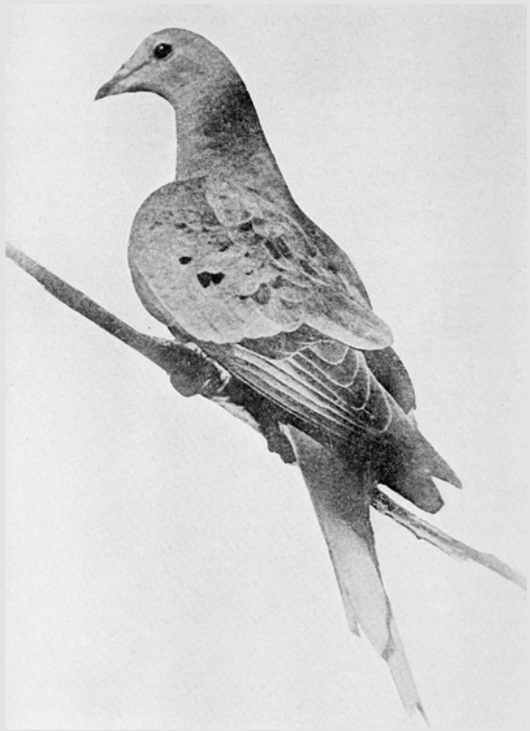
It is through the personal connections we develop with these animals that our impact on their lives, habitat, and communities becomes clear.

There is no doubt that Dian Fossey will remain a controversial figure in the history of conservation. She forced us all to ask questions about our place in nature and motivated the scientific community to examine how and why we describe animals the way that we do.

As American society debates issues such as exotic animals as pets, the role of animals in zoos, entertainment and medical research, and our personal role as international consumers and tourists, Fossey, like many other conservationists before and since, challenged us to look at these animals as intelligent and self-aware beings.

Our ability to see ourselves in the Digits and Cecils of the world may be Fossey's greatest contribution of all. ◆

100 years have gone by...still no Passenger Pigeons



Martha the pigeon. (Source: Wikipedia)

Published September 2014.

100 years ago this week, Martha, the last known passenger pigeon, died in her cage in a Cincinnati zoo. Martha and her kind came to a rapid end. As recently as 1860, billions of passenger pigeons had been flying around North America, and so great was their number that they often darkened the day-time sky.

Martha has become a cautionary tale of the human ability to extinguish other species. Joel Greenberg in his book *A Feathered River Across the Sky: The Passenger Pigeon's Flight to Extinction* (Bloomsbury, 2014), discusses how overhunting and elimination of the birds' habitat due to the spread of the railroad pushed the species to extinction.

Men shooting passenger pigeons. (Source: Wikimedia Commons)

Over a century has passed with no passenger pigeons. As scientists discuss whether we have entered into the planet's sixth period of mass extinction, what lessons should we learn from the disappearance of the passenger pigeon? Some scientists are even weighing whether or not to clone and resurrect the bird.

Here at Origins, we've compiled a few links to help you learn all you need to know about the history of our extinct fine-feathered-friend and what the future has in store. ◆

"A Century of Extinction," by Elizabeth Kolbert (*New Yorker*, August 30, 2014)

"Saving Our Birds," by John W. Fitzpatrick (*New York Times*, August 29, 2014)

"'Martha' The Last Passenger Pigeon," Smithsonian Institution, National Museum of Natural History

"The Flight of the Passenger Pigeon, Now 100 Years Extinct," by Krishnadev Calamur (National Public Radio, September 1, 2014)

"Century After Extinction, Passenger Pigeons Remain Iconic- And Scientists Hope to Bring Them Back," by Carl Zimmer (*National Geographic*, August 31, 2014)

"Why the Passenger Pigeon Went Extinct," by Barry Yeoman (*Audobon Magazine*, May-June 2014)

Project Passenger Pigeon

Pigeons. (Source: Smithsonian Libraries)

A Postcard from Djerdap, Serbia

By **BRENNA MILLER**

Published September 2014.

During a four-month trip this summer, my archival research took me to a number of prominent cities in the former Yugoslavia: to Belgrade, Serbia, as well as Tuzla and Sarajevo in Bosnia and Herzegovina. But while the cities of the ex-Yu are certainly loci of interest for researchers and tourists alike, in mid-June I decided to take a break from Belgrade for a weekend vacation to Djerdap National Park.

As one park guide put it, Djerdap proved to be a great place to discover “new places and the beauties of nature.” But it also served as a reminder for us urban people of the twenty-first century that rural spaces do not simply exist on the peripheries of either civilization or history.

Djerdap has served as a place of conquest and conflict, trade and industry, international cooperation and borders, and leisure and fun. Today, tourists to the park can enjoy and reflect these legacies too, while even becoming a part of it themselves.

The Djerdap National Park is located roughly a 4-hour drive from Belgrade, in northeastern Serbia along the Danube River. The park itself is roughly 640 square kilometers, and its landscape features a variety of mountains, forests, fields, lakes, and rivers. The park was established in 1974, one of many founded during the socialist period of Yugoslavia.

Djerdap is promoted as a touristic hotspot, alongside the region's vibrant cities. As such, it not only protects a variety of plants, animals, natural features, and archaeological sites, it also offers infrastructure and a variety of outdoor activities for visitors, such as hiking, biking, fishing, and boating.

The main natural attraction of the park is "the Iron Gates," a deep mountainous gorge and the narrowest point of the Danube River. Made actually of several "pinches" in the river, the banks of the gorge are the home of a roughly 8,000 year-old Mesolithic settlement called Lepinski Vir. Excavated in the late 1960s, the site revealed roughly 136 structures, including a central community with several temporary surrounding settlements. Tourist information suggests that for the people of Lepinski Vir, the gorge and the Danube perhaps served as a focus of spiritual life.

But, for later groups it became a symbol of conquest and power, as fortresses both up- and downstream from the Iron Gates attest. To hold the Iron Gates

chokepoint meant to control the river itself, as a thoroughfare for travel and trade through the rough mountainous terrain of the region. The Golubac Fortress is one site evidencing this strategic

interest, and, while the creator of the fortress is unknown, historical records suggest temporary (and often alternating) stewardship by the Romans and Byzantines, Bulgarians and Serbs, and later Ottomans and Hungarians. These waves of conquest each left their marks on the fortress, which grew and expanded over time to include 10 towers and the nearby village.

Downstream from the Iron Gates also lies the Roman Diana Fortress, located just outside the town of Kladovo. This fortress dates from around 100 CE, and was rebuilt several times as it changed hands over the next few centuries. Although it functioned primarily as a military stronghold, archaeologists have found evidence of civilian settlements inside the city.

Golubac and Diana both speak to the history of expansion and conquest in the Balkans. But the precarious location of these strongholds on testing terrains also speaks to the tremendous natural landscape of Djerdap, its strategic importance, and the commitment that it would have demanded to construct and staff these remote sites. As a tourist, one cannot help but to imagine what it would have been like to staff these fortresses. And time in Djerdap asks one to meditate on their history not just in terms of conquest of civilizations, but of the terrain itself.

In Djerdap, the connection between people and this natural environment spans into the 20thcentury as well. As irony would have it, my research in the Diplomatic Archive in Belgrade had

brought me in touch with Djerdap prior to my weekend visit. In the mid-1960s Yugoslavia and Romania began a cooperative industrial effort to construct a dam and hydroelectric power plant on the Danube. Djerdap-I was finished in 1972, and is still operational today. The plant is located downstream from the Iron Gates, and within view from the Roman Diana fortress. At the time, it was a symbol of international cooperation, and today also functions as a border crossing between Serbia and Romania.

While the dam produced electrical power, pride, and cooperation between these two countries, the construction of the Djerdap-I powerplant and dam did have its costs. Portions of Golubac have since been flooded, the Lepinski Vir archaeological site had to be moved further up the river bank, and an entire island (Ada Kaleh) was completely submerged.

Today visitors often travel to places like Djerdap to escape from cities and crowds, but my own trip to Djerdap was much more than just an encounter with nature. Sites like Lepinski Vir, Diana, Golubac, and the Djerdap-I plant suggest that while national parks can be places of solitude and timelessness, they can also be spaces to think about human history, and its intersections with the environment. ◆

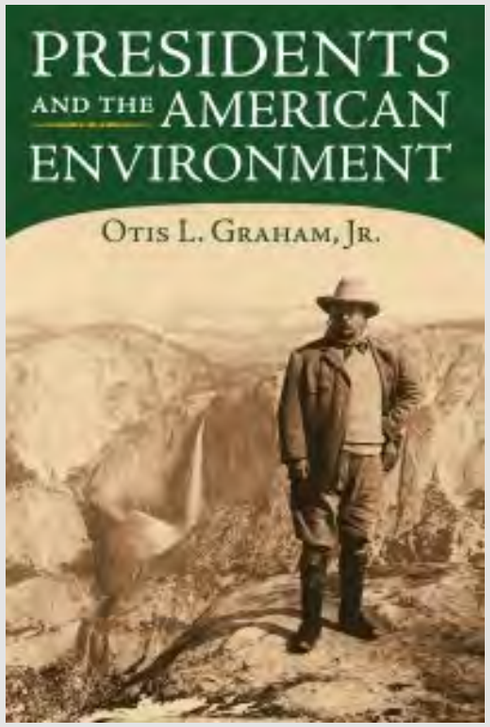
All photos taken by author.

Presidents and the American Environment

Book review by
PATRICK R. POTYONDY

Published September 2015.

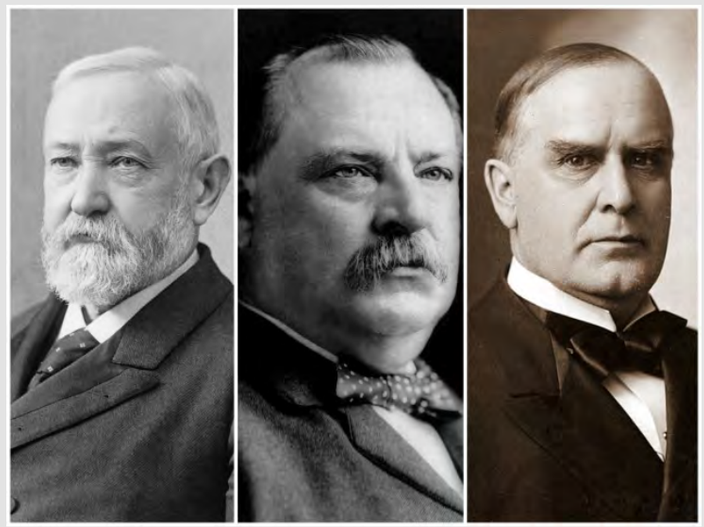
Presidents and the American Environmentby Otis L. Graham, Jr. (Lawrence, Kansas: University of Kansas Press, 2015).



by Otis L. Graham, Jr. (Lawrence, Kansas: University of Kansas Press, 2015)

I was lucky enough to grow up on the foothills of the Rocky Mountains in Colorado. To the west, steep forested peaks with crystal-clear lakes and streams. To the east, sweeping plains dotted with prairie dog holes and duck marshes. Rocky Mountain National Park was less than two hours away, as was Pawnee National Grassland. I took countless trips to both and many more federal areas like them. And I came to realize then, guided by a father who made a successful and rewarding career with the United States Forest Service, that my many happy memories of camping, fishing, and hunting trips in a variety of federally-protected areas would not have been possible without the conservation movement, and suffice it to say, several environmentally-conscious presidents, too.

And that impulse—conserving public lands across the nation in the service of the national public good—is the focus of Otis L.



Presidents Benjamin Harrison, Grover Cleveland, and William McKinley. The major similarity? Their general indifference toward conservation. Their major difference? A gradual reduction in facial hair. (Source: Wikipedia)

President Theodore Roosevelt helped solidify conservation as a national agenda item along with preservationist John Muir. (Source: Wikipedia)

Graham, Jr.'s *Presidents and the American Environment*. The book focuses primarily on conservation efforts and not so much "the environment" writ-large. After an introductory chapter covering a "first century without a national vision," Graham covers the presidents in chronological order beginning with the unimpressive trio of Benjamin Harrison, Grover Cleveland, and William McKinley.

Venturing forth, the reader finds a series of chapters organized around either a single president or several. Less a narrative, the book presents what might be more accurately labeled vignettes of each president, along with the major environmental issues he faced and the key players who surrounded him. The two Roosevelts—Teddy and Franklin—are the only presidents to merit a chapter of his own.

At times, the groupings make perfect sense: William Taft, Woodrow Wilson, Warren Harding, Calvin Coolidge, and Herbert Hoover are all lumped together for their fuzzy pro-market approaches to conservation—a departure from the vigorous conservation agenda of Theodore Roosevelt.

But it appears that social movements—and not presidents—just as often drive Graham's narrative. In another chapter subtitled "Environmentalism Arrives," Presidents Lyndon Baines Johnson, Richard Nixon, Gerald Ford, and Jimmy Carter mix it up. In yet another case, Ronald Reagan, George H.W. Bush, and Bill Clinton are thrown together in a somewhat bewilderingly-themed chapter subtitled "Presidents Brown and Green."

Organizational issues aside, the writing can really shine through, often making this reader chuckle. After noting that TR essentially preserved *one out of ten* acres of U.S. land (including Alaska!), Graham lays bare what was has been at stake had the more assertive conservation presidents like the two Roosevelts failed to act. If not preservation, Graham writes,

Imagine Donald Trump buying Yosemite as home for several lit-up resort hotels and casinos with their sprawling parking lots . . . the Mormon Church buying and closing Bryce Canyon to all but its members, and my family but not yours (because my great-grandfather, not yours, obtained it by fraud during the great land giveaway of the nineteenth century) enjoying a splendid, gated summer camp in one of the remaining groves of sequoias not felled to provide building material for expanding US cities and suburbs.

In another instance, the author presents a humorous "imagined conversation" between Presidents Teddy Roosevelt and Benjamin Harrison "here in the Afterlife!"

Presidents and the American Environment arrives at a perfect moment, one when conservatives have launched a state-by-state effort to decentralize control of well-regulated and managed federal lands down to the state level. Invoking the spirit of Warren Harding or Calvin Coolidge (though they may not realize it), they have also aligned themselves in the short term with the lawless Clive Bundy—neither realizes that there is a great *public* value

President Franklin Delano Roosevelt viewed conservation as important an issue as his predecessor Teddy. Here he enjoys a moment in 1933 with his newly-created Civilian Conservation Corps, which helped plant trees (a major passion of FDR's) and put young men back to work during the Depression. (Source: archives.gov)

inherent in places like Roosevelt National Forest, Yosemite, Yellowstone, or Death Valley.

In this context, Graham's work reminds us of the personalities it took to preserve these areas and why land was worth preserving in the first place at the national level. But readers looking for overarching themes or lessons from presidential history might be disappointed, or at the least, find them hard to spot. Most

readers, nonetheless, like this one, will enjoy the countless interesting anecdotes, refreshing and at times quirky prose, and the breadth of material covered—great fodder for both relaxed reading and dinner-party conversation.

To the dedicated, interested reader—Graham offers a treasure trove of facts and telling anecdotes, from Hoover declaring, in the wake of TR's monumental presidency, "Conservation is the settled policy of the government," to the fact that John Kennedy "preferred to spend time with the 'girls and mattresses' that came on the backup plane" to spending any time in the actual wilderness during his Western excursions.

Yet the lack of a strong argument is all the more disappointing given that the pendulum has swung so heavily toward anti-conservation interests. Several presidents, like Woodrow Wilson, Herbert Hoover, Harry Truman, and Dwight Eisenhower tended to encourage extractive industries to operate on federally-owned land and to push the construction of ever-larger dams. Today, Senator John McCain, along with several other conservative politicians, is pushing a similar agenda of private and corporate profit over preserving the public's environmental inheritance. One of these agenda items is a bill to allow highly destructive copper mining on a swath of land in Arizona which the Apache consider sacred.

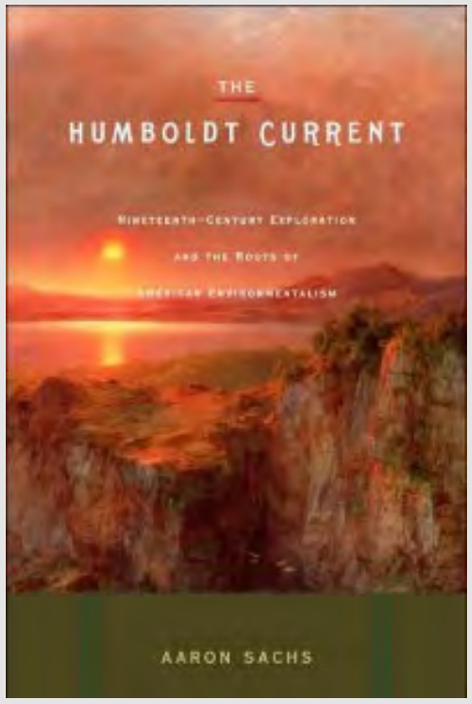
Graham's hesitancy to present a full-blown, overarching point not only tends to leave each chapter feeling a bit directionless, but it makes this reader wonder, how important have presidents—as a whole—really been to conservation? Graham offers in the introduction that they, generally, "have mattered, a little or a lot." And he illustrates that Teddy and FDR at least pulled more than their weight, with TR forcing conservation onto both parties' national agendas for decades to come and FDR splicing "conservation into the Democratic Party's DNA." But for so many of the others, it remains unclear what made each president do what they did, or didn't do, in the larger environment of American history. ◆

The Humboldt Current: Nineteenth-Century Exploration and the Roots of American Environmentalism

Book review by STEVEN CONN

Published June 2007.

The Humboldt Current: Nineteenth-Century Exploration and the Roots of American Environmentalism by Aaron Sachs (Viking Books, 2006).



by Aaron Sachs (Viking Books, 2006)

Humboldt, Nevada. Humboldt, Iowa. Humboldt County, California. The Humboldt River. All these places, and undoubtedly more besides, were named to honor a German naturalist who made exactly one brief visit to the United States early in the nineteenth century, but whose adventures and accomplishments were so much admired they made him an international celebrity.

Alexander von Humboldt (1769-1859) was surely among the greatest naturalists of his era. His expeditions to remote – remote, at least, from Europe – corners of the world, including South America and Siberia, resulted in a number of highly influential books. Yet despite his enormous reputation on both sides of the Atlantic during the nineteenth century, von Humboldt has faded from our imagination. Most people have some passing familiarity with Darwin; one suspects that many students at the California State University, Humboldt don't know much about the man for whom their alma mater is named.

One of the largest marine upwellings in the world, running north along the western coast of South America, also bears Humboldt's name. By one estimate, 20% of the world's fish catch comes from the extraordinary ecosystem called The Humboldt Current and it gives this book its title.

This current of cold ocean water, however, isn't what interests Cornell University historian Aaron Sachs. For Sachs, Humboldt should not command our attention because of any particular discovery, or because he developed a rigorously documented scientific theory. Rather, Humboldt's importance lies in having given expression to an important environmental ethos, for having given voice to a sensibility. What von Humboldt saw wherever he

explored was "the chain of connection" between all things. As he himself put it: "In considering the study of physical phenomena. . . , we find its noblest and most important result to be a knowledge of the chain of connection, by which all natural forces are linked together, and made mutually dependent on each other." (p. 12)

That line comes from von Humboldt's two-volume work *Cosmos* and Sachs reminds us that von Humboldt brought the word "cosmos" into common usage with the publication of that work. The science of ecology is generally said to begin with the German scientist Ernst Haeckel in the 1860s. Sachs argues, however, that von Humboldt observed and described those interconnections between all natural things including human beings as early as 1799 and that we ought to see von Humboldt as the founding figure of ecological thinking. Von Humboldt, for example, recognized that the falling water-level in a South American lake was undoubtedly the result of "the destruction of forests, the clearing of plains and the cultivation of indigo." (p. 77) Such observations and inductions turned von Humboldt from an explorer into a conservationist.

Alexander von Humboldt dies on p. 105 of this book, roughly a third of the way through. From there, Sachs explores the careers of four nineteenth century American scientists and follows a current of thought whose origin he traces back to the ideas articulated in von Humboldt's work: J. N. Reynolds, Clarence King, George Wallace Melville and John Muir.

Of the three, Reynolds is probably the least well-known, except perhaps to fans of Herman Melville who know Reynolds as the author of the 1839 tale: "Mocha Dick; or, The White Whale of the Pacific." Reynolds participated in one grand expedition to the Antarctic and organized another, though shifts in political winds meant that he was left ashore when the Great United States Exploring Expedition set sail in 1838. Melville too was a polar explorer, though of a later generation and of the other pole. Twice in the 1870s Melville was involved in exploring trips to the Arctic and both trips were attended by hardships and death of the sort that novelist Andrea Barrett has written about so wonderfully in her book *The Voyage of the Narwhal*. The portrait of Melville painted by Thomas Eakins, and discussed here by Sachs, reveals a man haunted by what he had endured.

Henry Adams, the nineteenth century's most remarkable autobiographer, regarded his friend Clarence King as the greatest figure of his generation. In the post-Civil War era he made important contributions to geology and explored sections of the Sierra Nevada region. On the strength of that work, Congress appointed him as the first director of the newly established US Geologic Survey, though he held the position for less than two years. John Muir also fell in love with the Sierras and founded the Sierra Club. For that, and for his fight to save the Hetch Hetchy

valley, the story of which has long since passed into legend, he remains the patron saint of the modern environmental movement.

Sachs ties these figures together by pointing to their shared Humboldtian thinking, though what defines that thinking is a bit fuzzy around the edges here. For all of them, Sachs points to the de-centering that comes with exploration, physical hardship, the eager embrace of the unfamiliar, and the humbling that comes from glimpsing the human place in the cosmos. For Reynolds and for King, for example, the Humboldtian ethos was translated into "humility" (see pp. 149 & 247). For Muir, Sachs finds Humboldt's influence in the former's ability to see and appreciate the relationship native Eskimos had with their environment (pp. 328-329).

In searching, as the subtitle states, for the "roots of American environmentalism," Sachs gives Muir perhaps the most interesting treatment. Sachs points out that after 1881, when Muir wrote about his trip to the Arctic where he saw those Eskimos, Muir rarely wrote again about Native people. As his career went on, Muir more and more wrote people out of the environment, seeing them only as destructive intrusions on the pristine wilderness. In this sense, Muir set up the opposition between human beings and the natural world that largely defines our environmental debate today. Picking up on the work of historians like William Cronon, Sachs points out that this is simply a false dichotomy; worse, it has enabled us to set aside specific places which we preserve and revere while simultaneously ignoring the way our daily lives intersect with, have on impact on, and in turn depend on the environment. How many visitors, for example, fail to see the irony of driving an SUV to get to Yosemite?

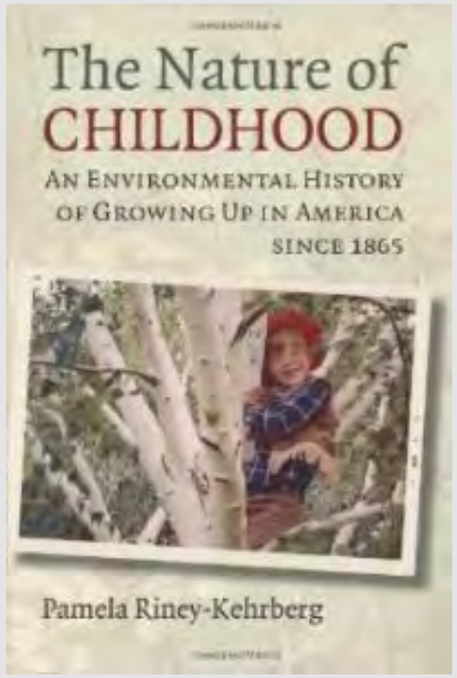
Sachs has taken the nineteenth century historian Francis Parkman at his word when Parkman wrote that writing history should rely "less on books than on such personal experiences as should, in some sense, identify [the historian] with his theme." Sachs interjects himself often in this book, weaving between the history and his own physical and intellectual wanderings. He sees himself as a Humboldtian explorer and in this book he invites us to come join him on the journey. ◆

The Nature of Childhood: An Environmental History of Growing Up in America Since 1865

Book review by DANIEL VANDERSOMMERS

Published May 2014.

The Nature of Childhood: An Environmental History of Growing Up in America Since 1865by Pamela Riney-Kehrberg (Lawrence: University Press of Kansas, 2014).



by Pamela Riney-Kehrberg (Lawrence: University Press of Kansas, 2014)

For this reviewer, who believes whole-heartedly that the best years in life fall between third grade and middle school, who currently spends much time going on picnics with a three-year-old son, and who tends to view the texting-'liking'-gaming culture of the twenty-first century suspiciously, *The Nature of Childhood: An Environmental History of Growing Up in America Since 1865* proved a timely, refreshing, and even nostalgic read.

Through its pages, historian Pamela Riney-Kehrberg presents an important history of childhood, as well as a significant work for contemporary activism. *The Nature of Childhood* is a convincingly argued and passionately-written monograph that explains how outdoor-children turned gradually into indoor-children between 1865 and the present.

The Nature of Childhood begins its story a period of major historical transition, when the United States began to hurtle along a path of industrialization and urbanization that would transform a nation "born in the country" into a nation defined by its cities (1). Riney-Kehrberg's central thesis is straightforward. Over the last 150 years, American "children's focus has, for the most part, moved indoors, and away from the naturally occurring and constructed landscapes beyond their homes." Not only did children move inside, but they also became "islanded," "progressively separated from adult space, and moved into their own spaces, designed specifically for children" (5). As a result, children increasingly found themselves in bounded spaces—playgrounds, McDonald's Play Places, backyards, and basements filled with televisions, computers, and Playstations.

Riney-Kehrberg describes how the grand country-to-city transition in American society was partially responsible for this sheltering of childhood. However, she also shows how children often (especially in the first half of the twentieth century) resisted this push, seizing their own outdoor play places despite pressure to do otherwise. Riney-Kehrberg does not blame urbanization, industrialization, population growth, or technological change for "islanding" our kids. What moved children indoors was the fear that these processes produced in American parents. *The Nature of Childhood* is a story about play and paranoia in modern America.

Riney-Kehrberg presents a loosely chronological narrative of American childhood in seven chapters, and she focuses on children growing up in the Midwest and Great Plains. Chapter One describes how rural children lived "premodern" lives close to "nature." Chapter Two shows how urban children transformed alleys and polluted rivers into play areas. This chapter also examines the rise of the playground as the first adult-sanctioned safe haven for children (64). Chapter Three explores how summer camps, scouting, and nature education proliferated in the early twentieth century for children who were increasingly losing their outdoor stomping grounds. Chapter Four continues with the topic of the previous chapter, examining the "tug-of-war between the lure of the indoors and adult desires to get children outdoors" in the mid-twentieth century (8). Instead of outdoor camps, though, this chapter introduces Smokey Bear, Ranger Rick, Woodsy Owl, and Bambi as tools for nature education. In Chapter Five, Riney-Kehrberg takes the reader to her own childhood "playground"—Denver's High Line Canal. Through this case study, the reader will see that between 1950 and 1970 resilient children combatted the pressure to move indoors by finding creative ways to utilize built environments. By the late twentieth century, though, as Chapter Six demonstrates, "[t]he day of the free-roaming child, exploring urban, suburban or wild space seemed to be over" (9). Children succumbed to televisions and shopping malls, and parents succumbed to the fear that their children were no longer safe outside. In the 1990s, some "voices in the wilderness," so to speak, reacted against the sheltering of childhood. Chapter Seven amplifies these voices and should itself be read as a call-for-action for parents.

Riney-Kehrberg not only uses a wide-range of newspapers, periodicals, television programs, films, websites, and published works to tell her story, but she also draws extensively from manuscripts found in Wisconsin, Iowa, Minnesota, Kansas, Colorado, and Nebraska archives. One of Riney-Kehrberg's strengths is her ability to uncover the voices of children in her sources. Indeed, the first chapters showcase this ability, as children themselves advance her argument. Filled with vivid stories of children playing around horse carcasses, swimming in sewage, hostelling in southern Wisconsin, and adventuring in high-rise elevators, *The Nature of Childhood* shows (and not just

"tells") how children, wherever they were in modern America, "made use of whatever spaces they had" (51).

The book is at its best when Riney-Kehrberg allows children to speak. The book is less good when focusing on the adult fears that kept children inside. Riney-Kehrberg laments the rise of parental fear, and she seems to suggest several times that this paranoia was (and is) largely unfounded. Nonetheless, she spends too little time developing this component of her argument. Fear is a prominent theme in historiographical debates concerning the United States after World War Two. Fear is also a significant topic in cultural studies, sociology, and psychology. For the historian of modern America, a nuanced discussion of parental fear would have situated parents and children more squarely in American history. For the activist, a more nuanced discussion of parental fear could have led to more productive discussions about how to fix the problem—about how to get children outside before we truly become a society that is, in Sherry Turkle's words, "alone together."

As an environmental history, *The Nature of Childhood* also falls a little flat, using concepts like "environment" and "nature" simplistically to signify either "beyond the house" or the "great outdoors." She could have made much more of both children's ever-changing relationships with their ever-changing environmental contexts and of children's role in shaping ideas about Nature writ large. Despite these weaknesses, *The Nature of Childhood* is a passionately-written and thought-provoking introduction to a topic that deserves far more attention by historians. ◆

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Origins: Current Events in Historical Perspective

"For insight into the complicated and complicating events ... , one needs perspective, not attitudes; context, not anecdotes; analyses, not postures. For any kind of lasting illumination the focus must be on the history routinely ignored or played down or unknown." — Toni Morrison

Origins: Current Events in Historical Perspective **connects history with today.**
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Every month since 2007, we've provided historical insight on current events that matter to the United States and to the world. Our main article appears on the 15th of each month and features an expert who analyzes a pressing issue—whether political, cultural, or social—in a broader, deeper context. *Origins'* main articles focus on the long-term trends and patterns, search for the foundations of today's events, and explore the often complicated nature of a particular current event.

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We hope that *Origins* will help you understand the world more fully. To provide the best and most interesting content, we have and continue to partner with other like-minded organizations. The final goal of *Origins* is to make us all more informed, engaged citizens. As the American philosopher John Dewey wrote,"History which is not brought down close to the actual scene of events leaves a gap."

We're also proud that *Origins* is a project of the Public History Initiative and eHistory in the History Department at The Ohio State University and the History Department at Miami University.

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(Cover Image: Maine Landscape by Laura Seeger)