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On the Edge

In the summer of 2010, record-high temperatures hit Moscow. At first it was just another heat wave, but the scorching heat that started in late June continued through mid-August. Western Russia was so hot and dry in early August that 300 or 400 new fires were starting every day. Millions of acres of forest burned. So did thousands of homes. Crops withered.[1]

Day after day, Moscow was bathed in seemingly endless smoke. The elderly and those with impaired respiratory systems struggled to breathe. The death rate climbed as heat stress and smoke took their toll.[2]

The average July temperature in Moscow was a scarcely believable 14 degrees Fahrenheit above the norm. Twice during the heat wave, the Moscow temperature exceeded 100 degrees Fahrenheit, a level Muscovites had never before experienced. Watching the heat wave play out over a seven-week period on the TV evening news, with the thousands of fires and the smoke everywhere, was like watching a horror film that had no end. Russia's 140 million people were in shock, traumatized by what was happening to them and their country.[3]

The most intense heat in Russia's 130 years of record-keeping was taking a heavy economic toll. The loss of standing forests and the projected cost of their restora-

tion totaled some $300 billion. Thousands of farmers faced bankruptcy.[4]

Russia's grain harvest shrank from nearly 100 million tons to scarcely 60 million tons as crops withered. Recently the world's number three wheat exporter, Russia banned grain exports in a desperate move to rein in soaring domestic food prices. Between mid-June and mid-August, the world price of wheat climbed 60 percent. Prolonged drought and the worst heat wave in Russian history were boosting food prices worldwide.[5]

But there was some good news coming out of Moscow. On July 30th, Russian President Dmitry Medvedev announced that in large parts of western Russia "practically everything is burning." While sweating, he went on to say, "What's happening with the planet's climate right now needs to be a wake up call to all of us." In something akin to a deathbed conversion, Russia's president was abandoning his country's position as a climate change denier and an opponent of carbon reduction initiatives.[6]

Even before the Russian heat wave ended, there were reports in late July of torrential rains in the mountains of northern Pakistan. The Indus River, the lifeline of Pakistan, and its tributaries were overflowing. Levees that had confined the river to a narrow channel so the fertile floodplains could be farmed had failed. Eventually the raging waters covered one fifth of the country.[7]

The destruction was everywhere. Some 2 million homes were damaged or destroyed. More than 20 million people were affected by the flooding. Nearly 2,000 Pakistanis died. Some 6 million acres of crops were damaged or destroyed. Over a million livestock drowned. Roads and bridges were washed away. Although the flooding was blamed on the heavy rainfall, there were actually several trends converging to produce what was described as the largest natural disaster in Pakistan's history.[8]

On May 26, 2010, the official temperature in Mohenjodaro in south-central Pakistan reached 128 degrees Fahrenheit, a record for Asia. Snow and glaciers in the western Himalayas, where the tributaries of the Indus River originate, were melting fast. As Pakistani glaciologist M. Iqbal Khan noted, the glacial melt was already swelling the flow of the Indus even before the rains came.[9]

The pressure of population on natural resources is intense. Pakistan's 185 million people are squeezed into an area 8 percent that of the United States. Ninety percent of the original forests in the Indus Basin are gone, leaving little to absorb the rainfall and reduce runoff. Beyond this, Pakistan has a livestock population of cattle, water buffalo, sheep, and goats of 149 million, well above the 103 million grazing livestock in the United States. The result is a country stripped of vegetation. When it rains, rapid runoff erodes the soil, silting up reservoirs and reducing their capacity to store flood water.[10]

Twenty or more years ago, Pakistan chose to define security largely in military terms. When it should have been investing in reforestation, soil conservation, education, and family planning, it was shortchanging these activities to bolster its military capacity. In 1990, the military budget was 15 times that of education and a staggering 44 times that of health and family planning. As a result, Pakistan is now a poor, overpopulated, environmentally devastated nuclear power where 60 percent of women cannot read and write.[11]

What happened to Russia and to Pakistan in the summer of 2010 are examples of what lies ahead for all of us if we continue with business as usual. The media described the heat wave in Russia and the flooding in Pakistan as natural disasters. But were they? Climate scientists have been saying for some time that rising temperatures would bring more extreme climate events. Ecologists have warned that as human pressures on

ecosystems mount and as forests and grasslands are destroyed, flooding will be more severe.[12]

The signs that our civilization is in trouble are multiplying. During most of the 6,000 years since civilization began we lived on the sustainable yield of the earth's natural systems. But in recent decades humanity has overshot the level that those systems can sustain.[13]

We are liquidating the earth's natural assets to fuel our consumption. Half of us live in countries where water tables are falling and wells are going dry. Soil erosion exceeds soil formation on one third of the world's cropland, draining the land of its fertility. The world's ever-growing herds of cattle, sheep, and goats are converting vast stretches of grassland to desert. Forests are shrinking by 13 million acres per year as we clear land for agriculture and cut trees for lumber and paper. Four fifths of oceanic fisheries are being fished at capacity or overfished and headed for collapse. In system after system, demand is overshooting supply.[14]

Meanwhile, with our massive burning of fossil fuels, we are overloading the atmosphere with carbon dioxide (CO_2), pushing the earth's temperature ever higher. This in turn generates more frequent and more extreme climatic events, including crop-withering heat waves, more intense droughts, more severe floods, and more destructive storms.[15]

The earth's rising temperature is also melting polar ice sheets and mountain glaciers. If the Greenland ice sheet, which is melting at an accelerating rate, were to melt entirely, it would inundate the rice-growing river deltas of Asia and many of the world's coastal cities. It is the ice melt from the mountain glaciers in the Himalayas and on the Tibetan Plateau that helps sustain the dry-season flow of the major rivers in India and China—the Ganges, Yangtze, and Yellow Rivers—and the irrigation systems that depend on them.[16]

At some point, what had been excessive local demands on environmental systems when the economy was small became global in scope. A 2002 study by a team of scientists led by Mathis Wackernagel aggregates the use of the earth's natural assets, including CO_2 overload in the atmosphere, into a single indicator—the ecological footprint. The authors concluded that humanity's collective demands first surpassed the earth's regenerative capacity around 1980. By 1999, global demands on the earth's natural systems exceeded sustainable yields by 20 percent. Ongoing calculations show it at 50 percent in 2007. Stated otherwise, it would take 1.5 Earths to sustain our current consumption. Environmentally, the world is in overshoot mode. If we use environmental indicators to evaluate our situation, then the global decline of the economy's natural support systems—the environmental decline that will lead to economic decline and social collapse—is well under way.[17]

No previous civilization has survived the ongoing destruction of its natural supports. Nor will ours. Yet economists look at the future through a different lens. Relying heavily on economic data to measure progress, they see the near 10-fold growth in the world economy since 1950 and the associated gains in living standards as the crowning achievement of our modern civilization. During this period, income per person worldwide climbed nearly fourfold, boosting living standards to previously unimaginable levels. A century ago, annual growth in the world economy was measured in the billions of dollars. Today, it is measured in the trillions. In the eyes of mainstream economists, the world has not only an illustrious economic past but also a promising future.[18]

Mainstream economists see the 2008–09 global economic recession and near-collapse of the international financial system as a bump in the road, albeit an unusu-

ally big one, before a return to growth as usual. Projections of economic growth, whether by the World Bank, Goldman Sachs, or Deutsche Bank, typically show the global economy expanding by roughly 3 percent a year. At this rate the 2010 economy would easily double in size by 2035. With these projections, economic growth in the decades ahead is more or less an extrapolation of the growth of recent decades.[19]

How did we get into this mess? Our market-based global economy as currently managed is in trouble. The market does many things well. It allocates resources with an efficiency that no central planner could even imagine, much less achieve. But as the world economy expanded some 20-fold over the last century it has revealed a flaw—a flaw so serious that if it is not corrected it will spell the end of civilization as we know it.[20]

The market, which sets prices, is not telling us the truth. It is omitting indirect costs that in some cases now dwarf direct costs. Consider gasoline. Pumping oil, refining it into gasoline, and delivering the gas to U.S. service stations may cost, say, $3 per gallon. The indirect costs, including climate change, treatment of respiratory illnesses, oil spills, and the U.S. military presence in the Middle East to ensure access to the oil, total $12 per gallon. Similar calculations can be done for coal.[21]

We delude ourselves with our accounting system. Leaving such huge costs off the books is a formula for bankruptcy. Environmental trends are the lead indicators telling us what lies ahead for the economy and ultimately for society itself. Falling water tables today signal rising food prices tomorrow. Shrinking polar ice sheets are a prelude to falling coastal real estate values.

Beyond this, mainstream economics pays little attention to the sustainable yield thresholds of the earth's natural systems. Modern economic thinking and policymaking have created an economy that is so out of

sync with the ecosystem on which it depends that it is approaching collapse. How can we assume that the growth of an economic system that is shrinking the earth's forests, eroding its soils, depleting its aquifers, collapsing its fisheries, elevating its temperature, and melting its ice sheets can simply be projected into the long-term future? What is the intellectual process underpinning these extrapolations?

We are facing a situation in economics today similar to that in astronomy when Copernicus arrived on the scene, a time when it was believed that the sun revolved around the earth. Just as Copernicus had to formulate a new astronomical worldview after several decades of celestial observations and mathematical calculations, we too must formulate a new economic worldview based on several decades of environmental observations and analyses.[22]

The archeological record indicates that civilizational collapse does not come suddenly out of the blue. Archeologists analyzing earlier civilizations talk about a decline-and-collapse scenario. Economic and social collapse was almost always preceded by a period of environmental decline.[23]

For past civilizations it was sometimes a single environmental trend that was primarily responsible for their decline. Sometimes it was multiple trends. For Sumer, it was rising salt concentrations in the soil as a result of an environmental flaw in the design of their otherwise extraordinary irrigation system. After a point, the salts accumulating in the soil led to a decline in wheat yields. The Sumerians then shifted to barley, a more salt-tolerant crop. But eventually barley yields also began to decline. The collapse of the civilization followed.[24]

Archeologist Robert McC. Adams describes the site of the ancient Sumerian civilization on the central floodplain of the Euphrates River in what is now Iraq as an

empty, desolate area now outside the frontiers of cultivation. He says, "Vegetation is sparse, and in many areas it is almost wholly absent….Yet at one time, here lay the core, the heartland, the oldest urban, literate civilization in the world."[25]

For the Mayans, it was deforestation and soil erosion. As more and more land was cleared for farming to support the expanding empire, soil erosion undermined the productivity of their tropical soils. A team of scientists from the National Aeronautics and Space Administration has noted that the extensive land clearing by the Mayans likely also altered the regional climate, reducing rainfall. In effect, the scientists suggest, it was the convergence of several environmental trends, some reinforcing others, that led to the food shortages that brought down the Mayan civilization.[26]

Although we live in a highly urbanized, technologically advanced society, we are as dependent on the earth's natural support systems as the Sumerians and Mayans were. If we continue with business as usual, civilizational collapse is no longer a matter of whether but when. We now have an economy that is destroying its natural support systems, one that has put us on a decline and collapse path. We are dangerously close to the edge. Peter Goldmark, former Rockefeller Foundation president, puts it well: "The death of our civilization is no longer a theory or an academic possibility; it is the road we're on."[27]

Judging by the archeological records of earlier civilizations, more often than not food shortages appear to have precipitated their decline and collapse. Given the advances of modern agriculture, I had long rejected the idea that food could be the weak link in our twenty-first century civilization. Today I think not only that it could be the weak link but that it is the weak link.[28]

The reality of our situation may soon become clearer

for mainstream economists as we begin to see some of the early economic effects of overconsuming the earth's resources, such as rising world food prices. We got a preview when, as world grain demand raced ahead and as supplies tightened in early 2007, the prices of wheat, rice, corn, and soybeans began to climb, tripling historical levels by the spring of 2008. Only the worst global economic downturn since the Great Depression, combined with a record world grain harvest in 2008, managed to check the rise in grain prices, at least for the time being. Since 2008, world market prices have receded somewhat, but as of October 2010, following the disastrous Russian grain harvest, they were still nearly double historical levels and rising.[29]

On the social front, the most disturbing trend is spreading hunger. For the last century's closing decades, the number of chronically hungry and malnourished people worldwide was shrinking, dropping to a low of 788 million by 1996. Then it began to rise—slowly at first, and then more rapidly—as the massive diversion of grain to produce fuel for cars doubled the annual growth in grain consumption. In 2008, it passed 900 million. By 2009, there were more than a billion hungry and malnourished people. The U.N. Food and Agriculture Organization anticipated a decline in the number of hungry people in 2010, but the Russian heat wave and the subsequent climb in grain prices may have ended that hope.[30]

This expansion in the ranks of the hungry is disturbing not only in humanitarian terms but also because spreading hunger preceded collapse for so many of the earlier civilizations whose archeological sites we now study. If we use spreading hunger as an indicator of the decline that precedes social collapse for our global civilization, then it began more than a decade ago.[31]

As environmental degradation and economic and social stresses mount, the more fragile governments are

having difficulty managing them. And as rapid population growth continues, cropland becomes scarce, wells go dry, forests disappear, soils erode, unemployment rises, and hunger spreads. In this situation, weaker governments are losing their credibility and their capacity to govern. They become failing states—countries whose governments can no longer provide personal security, food security, or basic social services, such as education and health care. For example, Somalia is now only a place on the map, not a nation state in any meaningful sense of the term.[32]

The term "failing state" has only recently become part of our working vocabulary. Among the many weaker governments breaking down under the mounting stresses are those in Afghanistan, Haiti, Nigeria, Pakistan, and Yemen. As the list of failing states grows longer each year, it raises a disturbing question: How many states must fail before our global civilization begins to unravel?[33]

How much longer can we remain in the decline phase, whether measured in natural asset liquidation, spreading hunger, or failing states, before our global civilization begins to break down? Even as we wrestle with the issues of resource scarcity, world population is continuing to grow. Tonight there will be 219,000 people at the dinner table who were not there last night, many of them with empty plates.[34]

If we continue with business as usual, how much time do we have before we see serious breakdowns in the global economy? The answer is, we do not know, because we have not been here before. But if we stay with business as usual, the time is more likely measured in years than in decades. We are now so close to the edge that it could come at any time. For example, what if the 2010 heat wave centered in Moscow had instead been centered in Chicago? In round numbers, the 40 percent drop from

Russia's recent harvests of nearly 100 million tons cost the world 40 million tons of grain, but a 40-percent drop in the far larger U.S. grain harvest of over 400 million tons would have cost 160 million tons.[35]

While projected world carryover stocks of grain (the amount remaining in the bin when the new harvest begins) for 2011 were reduced from 79 days of world consumption to 72 days by the Russian heat wave, they would have dropped to 52 days of consumption if the heat wave had been centered in Chicago. This level would be not only the lowest on record, but also well below the 62-day carryover that set the stage for the tripling of world grain prices in 2007–08.[36]

In short, if the July temperature in Chicago had averaged 14 degrees above the norm, as it did in Moscow, there would have been chaos in world grain markets. Grain prices would have climbed off the charts. Some grain-exporting countries, trying to hold down domestic food prices, would have restricted or even banned exports, as they did in 2007–08. The TV evening news would be dominated by footage of food riots in low-income grain-importing countries and by reports of governments falling as hunger spread. Grain-importing countries that export oil would be trying to barter oil for grain. Low-income grain importers would lose out. With governments falling and with confidence in the world grain market shattered, the global economy could have started to unravel.[37]

Food price stability now depends on a record or near-record world grain harvest every year. And climate change is not the only threat to food security. Spreading water shortages are also a huge, and perhaps even more imminent, threat to food security and political stability. Water-based "food bubbles" that artificially inflate grain production by depleting aquifers are starting to burst, and as they do, irrigation-based harvests are shrinking. The

first food bubble to burst is in Saudi Arabia, where the depletion of its fossil aquifer is virtually eliminating its 3-million-ton wheat harvest. And there are at least another 17 countries with food bubbles based on overpumping.[38]

The Saudi loss of some 3 million tons of wheat is less than 1 percent of the world wheat harvest, but the potential losses in some countries are much larger. The grain produced by overpumping in India feeds 175 million Indians, according to the World Bank. For China, the comparable number is 130 million people. We don't know exactly when these water-based food bubbles will burst, but it could be any time now.[39]

If world irrigation water use has peaked, or is about to, we are entering an era of intense competition for water resources. Expanding world food production fast enough to avoid future price rises will be much more difficult. A global civilization that adds 80 million people each year, even as its irrigation water supply is shrinking, could be in trouble.[40]

When water-based food bubbles burst in larger countries, like China and India, they will push up food prices worldwide, forcing a reduction in consumption among those who can least afford it: those who are already spending most of their income on food. Even now, many families are trying to survive on one meal a day. Those on the lower rungs of the global economic ladder, those even now hanging on by their fingertips, may start to lose their grip.

Further complicating our future, the world may be reaching peak water at more or less the same time that it hits peak oil. Fatih Birol, chief economist with the International Energy Agency, has said, "We should leave oil before it leaves us." I agree. If we can phase out the use of oil quickly enough to stabilize climate, it will also facilitate an orderly, managed transition to a carbon-free renewable energy economy. Otherwise we face intensifying competition among countries for dwindling oil supplies and continued vulnerability to soaring oil prices. And with our recently developed capacity to convert grain into oil (that is, ethanol), the price of grain is now tied to that of oil. Rising oil prices mean rising food prices.[41]

Once the world reaches peak oil and peak water, continuing population growth would mean a rapid drop in the per capita supply of both. And since both are central to food production, the effects on the food supply could leave many countries with potentially unmanageable stresses. And these are in addition to the threats posed by increasing climate volatility. As William Hague, Britain's newly appointed Foreign Secretary and the former leader of the Conservative Party, says, "You cannot have food, water, or energy security without climate security."[42]

Among other things, the situation in which we find ourselves pushes us to redefine security in twenty-first century terms. The time when military forces were the prime threat to security has faded into the past. The threats now are climate volatility, spreading water shortages, continuing population growth, spreading hunger, and failing states. The challenge is to devise new fiscal priorities that match these new security threats.

We are facing issues of near-overwhelming complexity and unprecedented urgency. Can we think systemically and fashion policies accordingly? Can we move fast enough to avoid economic decline and collapse? Can we change direction before we go over the edge?

We are in a race between natural and political tipping points, but we do not know exactly where nature's tipping points are. Nature determines these. Nature is the timekeeper, but we cannot see the clock.

The notion that our civilization is approaching its demise if we continue with business as usual is not an easy concept to grasp or accept. It is difficult to imagine

something we have not previously experienced. We hardly have even the vocabulary, much less the experience, to discuss this prospect.

To help us understand how we got so close to the edge, Parts I and II of this book document in detail the trends just described—the ongoing liquidation of the earth's natural assets, the growing number of hungry people, and the lengthening list of failing states.

Since it is the destruction of the economy's natural supports and disruption of the climate system that are driving the world toward the edge, these are the trends that must be reversed. To do so requires extraordinarily demanding measures, a fast shift away from business as usual to what we at the Earth Policy Institute call Plan B. This is described in Part III.

With a scale and urgency similar to the U.S. mobilization for World War II, Plan B has four components: a massive cut in global carbon emissions of 80 percent by 2020; the stabilization of world population at no more than 8 billion by 2040; the eradication of poverty; and the restoration of forests, soils, aquifers, and fisheries.

Carbon emissions can be cut by systematically raising world energy efficiency, by restructuring transport systems, and by shifting from burning fossil fuels to tapping the earth's wealth of wind, solar, and geothermal energy. The transition from fossil fuels to renewable sources of energy can be driven primarily by tax restructuring: steadily lowering income taxes and offsetting this reduction with a rise in the tax on carbon.

Two of the components of Plan B—stabilizing population and eradicating poverty—go hand in hand, reinforcing each other. This involves ensuring at least a primary school education for all children—girls as well as boys. It also means providing at least rudimentary village-level health care so that parents can be more confident that their children will survive to adulthood. And

women everywhere need access to reproductive health care and family planning services.

The fourth component, restoring the earth's natural systems and resources, involves, for example, a worldwide initiative to arrest the fall in water tables by raising water productivity. That implies shifting both to more-efficient irrigation systems and to more water-efficient crops. And for industries and cities, it implies doing worldwide what some are already doing—namely, continuously recycling water.

It is time to ban deforestation worldwide, as some countries already have done, and plant billions of trees to sequester carbon. We need a worldwide effort to conserve soil, similar to the U.S. response to the Dust Bowl of the 1930s.[43]

The Earth Policy Institute estimates that stabilizing population, eradicating poverty, and restoring the economy's natural support systems would cost less than $200 billion of additional expenditures a year—a mere one eighth of current world military spending. In effect, the Plan B budget encompassing the measures needed to prevent civilizational collapse is the new security budget.[44]

The situation the world faces now is even more urgent than the economic crisis of 2008 and 2009. Instead of a U.S. housing bubble, it is food bubbles based on overpumping and overplowing that cloud our future. Such food uncertainties are amplified by climate volatility and by more extreme weather events. Our challenge is not just to implement Plan B, but to do it quickly so we can move off the environmental decline path before the clock runs out.

One thing is certain—we are facing greater change than any generation in history. What is not clear is the source of this change. Will we stay with business as usual and enter a period of economic decline and spreading

chaos? Or will we quickly reorder priorities, acting at wartime speed to move the world onto an economic path that can sustain civilization?

Data, endnotes, and additional resources can be found on Earth Policy's Web site, at www.earth-policy.org.

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