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BOOK REVIEW

The book, Hubbert's Peak: The Impending Oil Crisis, by Professor Kenneth S. Deffeyes, Princeton University Press, 2001 is a "must read" for anyone wishing to understand what is happening in the world's oil supply. Predicting it, using the Hubbert method and an extension, Deffeyes shows all the evidence, and much of the "inside" information usually known only to those deeply involved in the oil business itself.

In short, sometime between 2004 and 2008, we can expect the world's supply of oil to peak, and thereafter it will begin to decline ever afterwards, slowly and steadily. This is a sobering message, forecasting the decline of the 100-year oil era we have all been living in. The impact is that the era of cheap energy will also decline and end, with significant impact upon the world economies unless strong steps are taken to replace oil with some other energy sources.

As the reader well knows, my own recommendation is that the only viable solution is the extraction of EM energy from the active vacuum, which all electrical power systems and circuits already do, but which is ignored in electrical engineering (it is present in physics, and Lee and Yang received the Nobel Prize 1957 for discovering the broken symmetry of opposite charges, thus showing that any dipole or dipolarity does indeed extract EM energy from the vacuum.

Deffeyes also considers what could go wrong with his prediction, and convincingly argues against any of the often suggested "remedies" preventing the decline.

This book is meticulous, with good scientific analysis by an experienced geologist and professor, and yet it is simply and delightfully written. Deffeyes is still a Professor Emeritus at

Princeton University, and well-known in the field.

Considering the new war we have just entered, and other factors building, there now is a much-increased probability that much of the world's supply of oil will be disrupted by additional actions resulting from that war and from other factors. For example, China has declared the South China Sea the territorial waters of China. Some 60% or so of the oil for Japan, as well as oil for some other nations, passes through the South China Sea. As can be seen by looking at a map, a substantial percentage of the world's oil supply is in nations not too friendly -- or even hostile -- to the United States and to much of the Western nations.

In the war, as the action unfolds and intensifies, the infrastructure of the oil industry is also deadly vulnerable to terrorist attack. Long pipelines, refineries, storage areas, tankers and tanker routes, all are subject to attack and destruction or substantial damage. Does anyone remember the Texas City disaster??? Think about it.

Monsanto Chemical Plant, Texas City
April 16, 1947
600 killed
From The Collection of Ben R. Reynolds

In my view, further developments in this war could well increase the criticality of Deffeyes' analysis and conclusion. I believe we are in a looming crisis already, just now rearing up to bite us hard in the near future. Remember not long back when President Clinton released some oil out of our national

reserve to ease the gasoline crisis? The oil had to be shipped overseas to be refined, because we are so short on refineries, and the ones we had were working to capacity, with some down for inevitable maintenance. Further, Saddam Hussein has definitely shown us he has no compunction about setting entire oil fields ablaze.

We also express our deep appreciation to Princeton University Press for permission to place the first chapter of the book on our website, to give you a flavor and taste of what is in the book.

Let me close with a quote from Deffeyes:

"Fossil fuels are a one-time gift that lifted us from subsistence agriculture and eventually should lead us to a future based on renewable resources." About proposed initiatives to increase the production, processing, and availability of oil, he also says: "This much is certain... No initiative put in place starting today can have a substantial effect on the peak production year. No Caspian Sea exploration, no drilling in the South China Sea, no SUV replacements, no renewable energy projects can be brought on at a sufficient rate to avoid a bidding war for the remaining oil."

He also points out that "Running out of energy in the long run is not the problem.... The bind comes during the next 10 years: getting over our dependence on crude oil."

Professor Deffeyes' cogent analysis and delightful but sobering book is very timely, even critical, and he has done all of us a magnificent service in producing this vital message as a "wake-up" call that must be heeded. I only have two additional things to suggest examining: (1) Electrical power systems freely extracting their EM energy from the vacuum, and even powering themselves with it as well as their loads, can be readied for mass production in one year, from at least two inventors already possessing successful prototypes, and (2) an inventor I personally know has ready for production an advanced combustion process (heater) that provides about 300% more heat from the fuel it burns than does any other known heater (his process also efficiently extracts energy from the vacuum). His burner process -- already robust -- could be quickly scaled up and applied to rather dramatically

reduce the amount of fuel burned in our existing powerplants to boil water and make steam to run the steam turbines that power the generators. In other words, these two additional areas -- not known to Professor Deffeyes -- could with sufficient funding do the job required to prevent the coming dramatic effect on the world economy.
I most strongly recommend Prof. Deffeyes' book to every concerned reader. If you purchase and read only one book this year on energy, it should definitely be this book. This one is a bulls eye.

Tom Bearden, Ph.D.

The Tom Bearden Website

"Hubbert's Peak" review

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Hubbert's Peak:

The Impending World Oil Shortage

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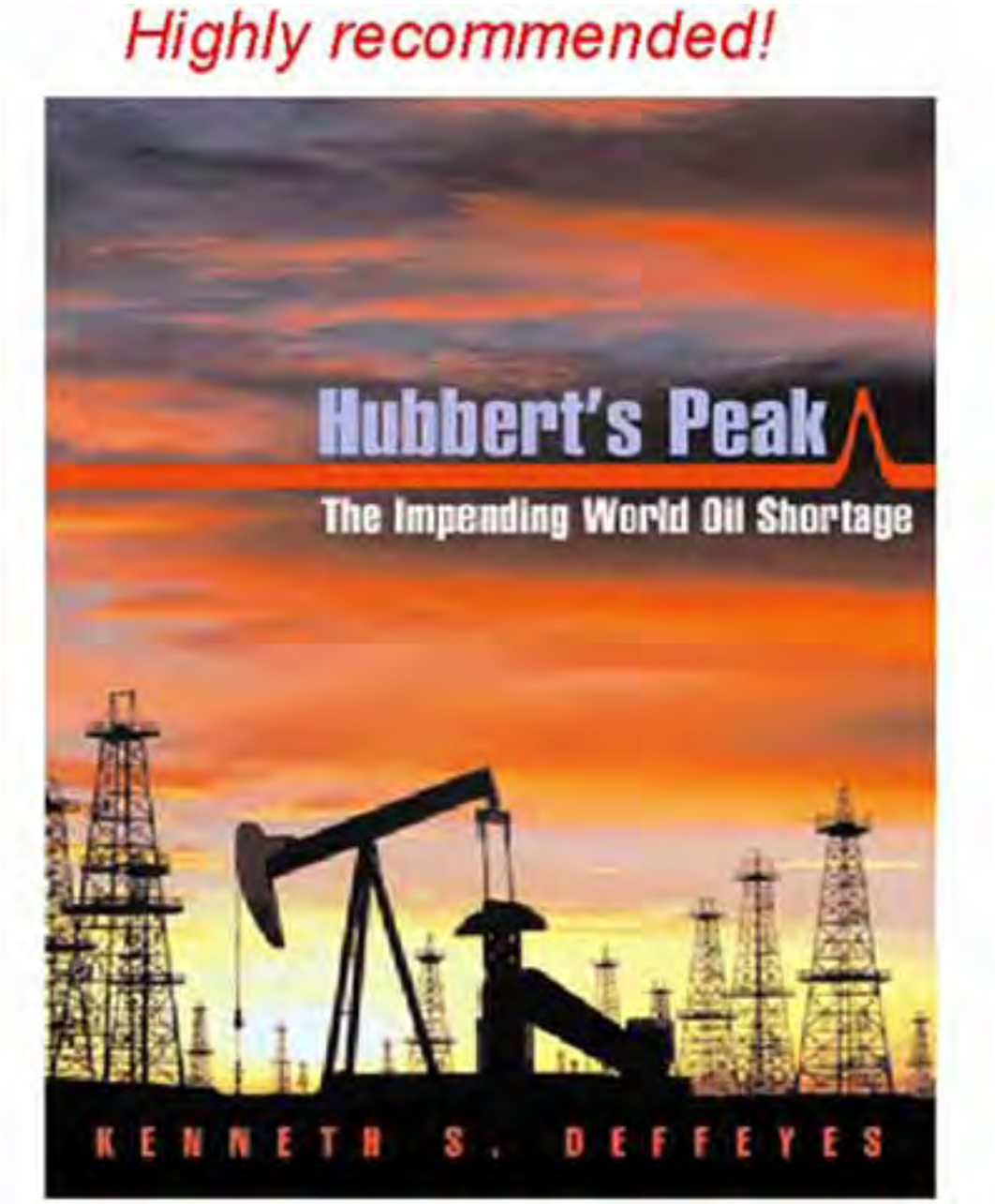
Book by Kenneth S. Deffeyes
Princeton University Press, 2001

Review by Tom Bearden



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Executive Summary

- In 1956, M. King Hubbert, Shell geologist and oil scientist, predicted U.S. oil production would peak in early 1970s, decline thereafter
  - Factions pro and con arose, argued.
  - Peak actually occurred in 1970.
- Oil becomes more expensive, less competitive as production costs mount
  - Easily-extracted oil cheapest, used up first
  - As extraction difficulty and processing rise steadily, oil increases in price.
  - Becomes noncompetitive
  - Developing alternatives on a large scale will take at least 10 years..
- Debeyes calculated peaking of global oil production in 2003 (2004-2008 used, to allow for statistical uncertainty).
- Comment: the new war may exacerbate the situation, although oil demand just now declining.

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Is there any way out?

- *Develop more advanced new oil technology*
  - Billions of dollars already poured into it.
  - Technology is already very highly developed.
  - Seems little additional improvement possible.
  - Most "new wheels" are already invented.
- *Drill deeper.*
  - Beyond 15,000 feet, there is natural gas but little oil.
  - Deep drilling rigs available and used since 1938.

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Is there any way out? (cont'd)

- *Drill someplace new*
  - Geologists ave already gone to the ends of the earth.
  - Only promising area appears to be part of the South China Sea area.
  - Several islands and a quirk of international law result in many drilling rights being claimed by six nations.
  - Little likelihood of a new Middle East find.
- *Comment:*
  - China declared South China Sea its territorial waters.
  - Recent maneuvering of U.S. Naval task force in the area.

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Is there any way out? (end)

- *Speed up exploration.*
  - Takes 10 years from a cold start to delivery of first oil.
  - Nothing we initiate now will produce significant oil before 2004-2008 shortage begins.
  -
- *Steep price increase in oil.*
  - Allows use of higher priced, difficult-to get oil.
  - Impacts the economy and suppresses it (self-defeating).
- *Comment:*
  - Developed nations' economies based on cheap energy; will be interrupted and suppressed.

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What should be done?

- Deffeyes recommends:
  - Increase energy conservation.
  - Design alternative energy sources.
  - Begin now, to prepare before oil decline's impact.
- *Deffeyes does not recommend:*
  - Guilt feelings, burning dung, etc.
  - Giving up cars, riding bicycles.
- *His basic purpose:*
  - Explain origin, exploration, production, marketing of oil.
  - Give the reader some expertise to evaluate the problem.
  - At the end, suggestions for preparing for the inevitable.

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Our comments: *Superb book!*

- Excellent book, expert analysis.
- Gives invaluable background.
- Highly recommended as "must purchase and read".
- Suggest also including known:
  - EM energy-from-the-vacuum self-powering systems.
  - COP > 1.0 combustion systems ready for mass production and use in present electrical power systems to heat water and make steam.

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CHAPTER 1

Overview

Global oil production will probably reach a peak sometime during this decade. After the peak, the world's production of crude oil will fall, never to rise again. The world will not run out of energy, but developing alternative energy sources on a large scale will take at least 10 years. The slowdown in oil production may already be beginning; the current price fluctuations for crude oil and natural gas may be the preamble to a major crisis.

In 1956, the geologist M. King Hubbert predicted that U.S. oil production would peak in the early 1970s.[1] Almost everyone, inside and outside the oil industry, rejected Hubbert's analysis. The controversy raged until 1970, when the U.S. production of crude oil started to fall. Hubbert was right.

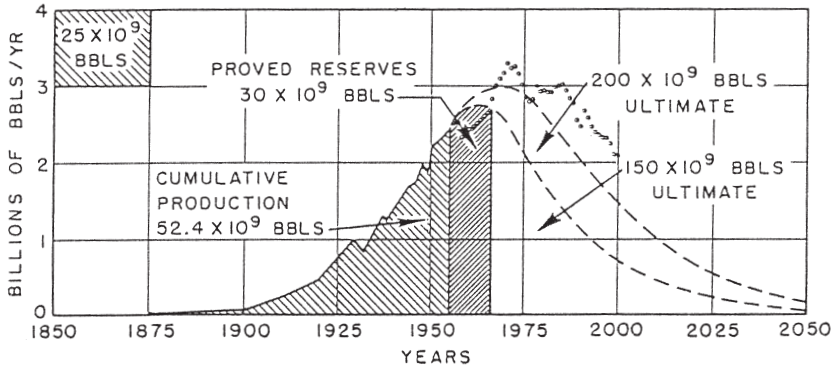
Around 1995, several analysts began applying Hubbert's method to world oil production, and most of them estimate that the peak year for world oil will be between 2004 and 2008. These analyses were reported in some of the most widely circulated sources: *Nature, Science,* and *Scientific American*.[2] None of our political leaders seem to be paying attention. If the predictions are correct, there will be enormous effects on the world economy. Even the poorest nations need fuel to run irrigation pumps. The industrialized nations will be bidding against one another for the dwindling oil supply. The good news is that we

M. King Hubbert (1903–89) was an American geophysicist who made important contributions to understanding fluid flow and the strength and behavior of rock bodies. Hubbert was at the Shell research lab in Houston when he made his original estimates of future oil production; he continued the work at the U.S. Geological Survey.

will put less carbon dioxide into the atmosphere. The bad news is that my pickup truck has a 25-gallon tank.

The experts are making their 2004–8 predictions by building on Hubbert's pioneering work. Hubbert made his 1956 prediction at a meeting of the American Petroleum Institute in San Antonio, where he predicted that U.S. oil production would peak in the early 1970s. He said later that the Shell Oil head office was on the phone right down to the last five minutes before the talk, asking Hubbert to withdraw his prediction. Hubbert had an exceedingly combative personality, and he went through with his announcement.

I went to work in 1958 at the Shell research lab in Houston, where Hubbert was the star of the show. He had extensive scientific accomplishments in addition to his oil prediction. His belligerence during technical arguments gave rise to a saying around the lab, "That



On Hubbert's original 1956 graph, the lower dashed curve on the right gives Hubbert's estimate of U.S. oil production rates if the ultimate discoverable oil beneath the curve is 150 billion barrels. The upper dashed line, for 200 billion barrels, was his famous prediction that U.S. oil production would peak in the early 1970s. The actual U.S. oil production for 1956 through 2000 is superimposed as small circles. Since 1985, the United States has produced slightly more oil than Hubbert's prediction, largely because of successes in Alaska and in the far offshore Gulf Coast.

Hubbert is a bastard, but at least he's *our* bastard." Luckily, I got off to a good start with Hubbert; he remained a good friend for the rest of his life.

Critics had many different reasons for rejecting Hubbert's oil prediction. Some were simply emotional; the oil business was highly profitable, and many people did not want to hear that the party would soon be over. A deeper reason was that many false prophets had appeared before. From 1900 onward, several of these people had divided the then known U.S. oil reserves by the annual rate of production. (Barrels of reserves divided by barrels per year gives an answer in years.) The typical answer was 10 years. Each of these forecasters started screaming that the U.S. petroleum industry would die in 10 years. They cried "wolf." During each ensuing 10 years, more oil reserves were added, and the industry actually grew instead of drying up. In 1956, many critics thought that Hubbert was yet another false prophet. Up through 1970, those who were following the story divided into pro-Hubbert and anti-Hubbert factions. One pro-Hubbert

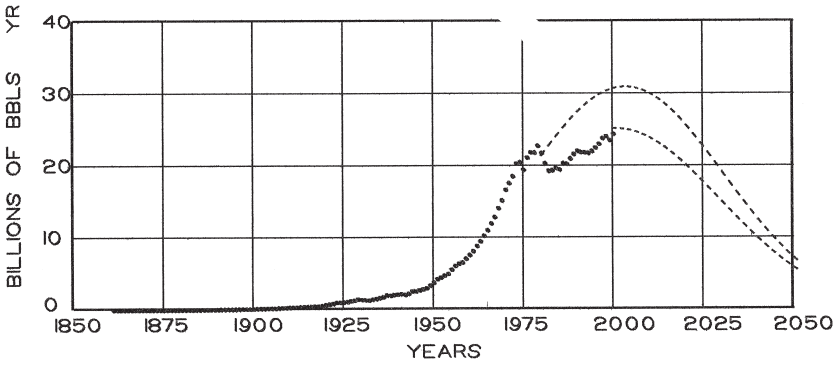
publication had the wonderful title "This Time the Wolf Really *Is* at the Door."[3]

Hubbert's 1956 analysis tried out two different educated guesses for the amount of U.S. oil that would eventually be discovered and produced by conventional means: 150 billion and 200 billion barrels. He then made plausible estimates of future oil production rates for each of the two guesses. Even the more optimistic estimate, 200 billion barrels, led to a predicted peak of U.S. oil production in the early 1970s. The actual peak year turned out to be 1970.

Today, we can do something similar for world oil production. One educated guess of ultimate world recovery, 1.8 trillion barrels, comes from a 1997 country-by-country evaluation by Colin J. Campbell, an independent oil-industry consultant.[4] In 1982, Hubbert's last published paper contained a world estimate of 2.1 trillion barrels.[5] Hubbert's 1956 method leads to a peak year of 2001 for the 1.8-trillion-barrel estimate and a peak year of 2003 or 2004 for 2.1 trillion barrels. The prediction based on 1.8 trillion barrels makes a better match to the most recent 10 years of world production.

In 1962, I became concerned that the U.S. oil business might not be healthy by the time I was scheduled to retire. I was in no mood to move to Libya. My reaction was to get a photocopy of Hubbert's raw numbers; I made my own analysis using different mathematics. In my analysis, and in Hubbert's, the domestic oil industry would be down to half its peak size by 1998. Fortunately, universities were expanding rapidly in the post-Sputnik era, and I had no trouble moving into academe.

Hubbert's prediction was fully confirmed in the spring of 1971. The announcement was made publicly, but it was almost an encoded message. The *San Francisco Chronicle* contained this one-sentence item: "The Texas Railroad Commission announced a 100 percent allowable for next month." I went home and said, "Old Hubbert was right." It still strikes me as odd that understanding the newspaper item required knowing that the Texas Railroad Commission, many years earlier, had been assigned the task of matching oil production to demand. In essence, it was a government-sanctioned cartel. Texas oil production



World oil production through the year 2000 is shown as heavy dots. Chapter 7 explains how Hubbert's methods were used to estimate the most likely future production. The dashed lines on the right show the probable production rates if the ultimate discoverable oil is 1.8 trillion barrels (the area under the lower curve) or 2.1 trillion barrels (upper curve).

so dominated the industry that regulating each Texas oil well to a percentage of its capacity was enough to maintain oil prices. The Organization of Petroleum Exporting Countries (OPEC) was modeled after the Texas Railroad Commission.[6] Just substitute Saudi Arabia for Texas.

With Texas, and every other state, producing at full capacity from 1971 onward, the United States had no way to increase production in an emergency. During the first Middle East oil crisis in 1967, it was possible to open up the valves in Ward and Winkler Counties in west Texas and partially make up for lost imports. Since 1971, we have been dependent on OPEC.

After his prediction was confirmed, Hubbert became something of a folk hero for conservationists. In contrast to the hundreds of millions of years it took for the world's oil endowment to accumulate, most of the oil is being produced in 100 years. The short bump of oil exploitation on the geologic time line became known as "Hubbert's peak."

In chapter 7, I explain how Hubbert used oil production and oil reserves to predict the future. We scientists don't like to admit it, but we often guess at the answer and then gather up some numbers to sup-

The 100-year period when most of the world's oil will be produced is known as "Hubbert's peak." On this scale, the geologic time needed to form the oil resources can be visualized by extending the line five miles to the left.

port the guess. A certain level of honesty is required; if the numbers do not justify my guess, I don't fake the numbers. I generate another guess. Hubbert's oil prediction was just barely within the envelope of acceptable scientific methods. It was as much an inspired guess as it was hard-core science.

This cautionary note is needed here: in the late 1980s there were huge and abrupt increases in the announced oil reserves for several OPEC nations.[7] Oil reserves are a vital ingredient in Hubbert's analysis. Earlier, each OPEC nation was assigned a share of the oil market based on the country's annual production capacity. OPEC changed the rule in the 1980s to consider also the oil reserves of each country. Most OPEC countries promptly increased their reserve estimates. These increases are not necessarily wrong; they are not necessarily fraudulent. "Reserves" exist in the eye of the beholder.

Oil reserves are defined as future production, using existing technology, from wells that have already been drilled (not to be confused with the U.S. "strategic petroleum reserve," which is a storage facility for oil that has already been produced). Typically, young petroleum engineers unconsciously tend to underestimate reserves. It's a lot more fun to go into the boss's office next year and announce that there is actually a little *more* oil than last year's estimate. Engineers who have to downsize their previous reserve estimates are the first to leave in the next corporate downsizing.

The abrupt increase in announced OPEC reserves in the late 1980s was probably a mixture of updating old underestimates and some wishful thinking. A Hubbert prediction requires inserting some hard, cold reserve numbers into the calculation. The warm fuzzy num-

bers from OPEC probably give an overly optimistic view of future oil production. So who is supposed to know?

A firm in Geneva, Switzerland, called Petroconsultants, maintained a huge private database. One long-standing rumor said that the U.S. Central Intelligence Agency was Petroconsultants' largest client. I would hope that between them, the CIA and Petroconsultants had inside information on the real OPEC reserves. This much is known: the loudest warnings about the predicted peak of world oil production came from Petroconsultants.[8] My guess is that they were using data not available to the rest of us.

A permanent and irreversible decline in world oil production would have both economic and psychological effects. So who is paying attention? The news media tell us that the recent increases in energy prices are caused by an assortment of regulations, taxes, and distribution problems. During the election campaign of 2000, none of the presidential candidates told us that the sky was about to fall. The public attention to the predicted oil shortfall is essentially zero.

In private, the OPEC oil ministers probably know about the articles in *Science, Nature,* and *Scientific American*. Detailed articles, with contrasting opinions, have been published frequently in the *Oil and Gas Journal*.[9] Crude oil prices have doubled in the past year. I suspect that OPEC knows that a global oil shortage may be only a few years away. The OPEC countries can trickle out just enough oil to keep the world economies functioning until that glorious day when they can market their remaining oil at mind-boggling prices.

It is not clear whether the major oil companies are facing up to the problem. Most of them display a business-as-usual facade. My limited attempts at spying turned up nothing useful. A company taking the 2004–8 hypothesis seriously would be willing to pay top dollar for existing oil fields. There does not seem to be an orgy of reserve acquisitions in progress.

Internally, the oil industry has an unusual psychology. Exploring for oil is an inherently discouraging activity. Nine out of 10 exploration wells are dry holes. Only one in a hundred exploration wells discovers an important oil field. Darwinian selection is involved: only

the incurable optimists stay. They tell each other stories about a Texas county that started with 30 dry holes yet the next well was a major discovery. "Never is heard a discouraging word." A permanent drop in world oil production beginning in this decade is definitely a discouraging word.

Is there any way out? Is there some way the crisis could be averted?

New Technology. One of the responses in the 1980s was to ask for a double helping of new technology. Here is the problem: before 1995 (when the dot.com era began), the oil industry earned a higher rate of return on invested capital than any other industry. When oil companies tried to use some of their earnings to diversify, they discovered that everything else was less profitable than oil. Their only investment option was doing research to make their own exploration and production operations even more profitable. Billions of dollars went into petroleum technology development, and much of the work was successful. That makes it difficult to ask today for new technology. Most of those wheels have already been invented.

Drill Deeper. The next chapter of this book explains that there is an "oil window" that depends on subsurface temperatures. The rule of thumb says that temperatures 7,500 feet down are hot enough to "crack" organic-rich sediments into oil molecules. However, beyond 15,000 feet the rocks are so hot that the oil molecules are further cracked into natural gas. The range from 7,000 to 15,000 feet is called the "oil window." If you drill deeper than 15,000 feet, you can find natural gas but little oil. Drilling rigs capable of penetrating to 15,000 feet became available in 1938.

Drill Someplace New. Geologists have gone to the ends of the Earth in their search for oil. The only rock outcrops in the jungle are in the banks of rivers and streams; geologists waded up the streams picking leeches off their legs. A typical field geologist's comment about jungle, desert, or tundra was: "She's medium-tough country." As an example,

This 1940s rig could drill through to the bottom of the oil window. Derricks like this, although rarely used after 1950, are still a visual metaphor for the oil industry. © Bettmann/CORBIS.

at the very northernmost tip of Alaska, at Point Barrow, the United States set up Naval Petroleum Reserve #4 in 1923.[10] As early as 1923, somebody knew that the Arctic Slope of Alaska would be a major oil producer.

Today, about the only promising petroleum province that remains unexplored is part of the South China Sea, where exploration has been delayed by a political problem. International law divides oil ownership at sea along lines halfway between the adjacent coastlines. A valid claim to an island in the ocean pushes the boundary out to halfway between the island and the farther coast. It apparently does

not matter whether the island is just a protruding rock with every third wave washing over the rock. Ownership of that rock can confer title to billions of barrels of oil. You guessed it: several islands stick up in the middle of the South China Sea, and the drilling rights are claimed by six different countries. Although the South China Sea is an attractive prospect, there is little likelihood that it is another Middle East.

Speed Up Exploration. It takes a minimum of 10 years to go from a cold start on a new province to delivery of the first oil. One of the legendary oil finders, Hollis Hedberg, explained it in terms of "the story." When you start out in a new area, you want to know whether the oil is trapped in folds, in reefs, in sand lenses, or along faults. You want to know which are the good reservoir rocks and which are the good cap rocks. The answers to those questions are "the story." After you spend a few years in exploration work and drilling holes, you figure out "the story." For instance, the oil is in fossil patch reefs. Then pow, pow, pow—you bring in discovery after discovery in patch reefs. Even then, there are development wells to drill and pipelines to install. It works, but it takes 10 years. Nothing we initiate now will produce significant oil before the 2004–8 shortage begins.

To summarize: it looks as if an unprecedented crisis is just over the horizon. There will be chaos in the oil industry, in governments, and in national economies. Even if governments and industries were to recognize the problems, it is too late to reverse the trend. Oil production is going to shrink. In an earlier, politically incorrect era the scene would be described as a "Chinese fire drill."

What will happen to the rest of us? In a sense, the oil crises of the 1970s and 1980s were a laboratory test. We were the lab rats in that experiment. Gasoline was rationed both by price and by the inconvenience of long lines at the gas stations. The increased price of gasoline and diesel fuel raised the cost of transporting food to the grocery store. We were told that 90 percent of an Iowa corn farmer's costs were, directly and indirectly, fossil fuel costs. As price rises rippled through the economy, there were many unpleasant disruptions.

Everyone was affected. One might guess that professors at Ivy League universities would be highly insulated from the rough-and-tumble world. I taught at Princeton from 1967 to 1997; faculty morale was at its lowest in the years around 1980. Inflation was raising the cost of living far faster than salaries increased. Many of us lived in university-owned apartments, and the university was raising our apartment rents in step with an imaginary outside "market" price. Our real standard of living went progressively lower for several years in a row. That was life (with tenure) inside the sheltered ivory tower; outside it was much tougher.

What should we do? Doing nothing is essentially betting against Hubbert. Ignoring the problem is equivalent to wagering that world oil production will continue to increase forever. My recommendation is for us to bet that the prediction is roughly correct. Planning for increased energy conservation and designing alternative energy sources should begin now to make good use of the few years before the crisis actually happens.

One possible stance, which I am not taking, says that we are despoiling the Earth, raping the resources, fouling the air, and that we should eat only organic food and ride bicycles. Guilt feelings will not prevent the chaos that threatens us. I ride a bicycle and walk a lot, but I confess that part of my motivation is the miserable parking situation in Princeton. Organic farming can feed only a small part of the world population; the global supply of cow dung is limited. A better civilization is not likely to arise spontaneously out of a pile of guilty consciences. We need to face the problem cheerfully and try to cope with it in a way that minimizes problems in the future.

The substance of this book is an explanation of the origin, exploration, production, and marketing of oil. This background about the industry is important because it sets geologic constraints on our future options. I describe the strengths and weaknesses of Hubbert's prediction methods and end with some suggestions about preparing for the inevitable. My intention is to give the reader some expertise in evaluating the problems. The experts' scenario for 2004–8 reads like

the opening passage of a horror movie. You have to make up your own mind about whether to accept their scary account.

My own opinion is that the peak in world oil production may even occur before 2004. What happens if I am wrong? I would be delighted to be proved wrong. It would mean that we have a few additional years to reduce our consumption of crude oil. However, it would take a lot of unexpectedly good news to postpone the peak to 2010. My message would remain much the same: crude oil is much too valuable to be burned as a fuel.

Stephen Jay Gould is fond of pointing out that we all have difficulty rising above our cultural biases. ("All" in that sentence includes Gould.) It helps if I identify the roots of my biases. Here is my confession:

I was born in the middle of the Oklahoma City oil field. I grew up in the oil patch. My father, J. A. "Dee" Deffeyes, was a pioneering petroleum engineer. In those days, companies moved employees around wherever they were needed. I went to nine different grade schools getting through the first eight grades. During high school and college, each summer I had a different job in the oil industry: laboratory assistant, pipeyard worker, roustabout, seismic crew.

After I graduated from the Colorado School of Mines, I worked for the exploration department of Shell Oil. Right at the end of the Korean War, everybody my age got drafted. There weren't many of us. I was one of the few born right in the pit bottom of the Great Depression. I wanted to have my revenge on the army by using up my G.I. Bill at the most expensive school I could find. The geology department at Princeton turned out to be fabulous.

After graduate school, I was delighted to be asked to rejoin Shell at its research lab in Houston. Scientific progress happened very rapidly at the Shell lab. Jerry Wasserburg of Cal Tech, not known for passing out compliments freely, said that the Shell research lab in that era was the best Earth science research organization in the world. As I mentioned, it was Hubbert's prediction that caused me to get out of the oil business.

I taught briefly at Minnesota and Oregon State, and in 1967 I joined the Princeton faculty. In addition to teaching, I had the pleasure of cooperating with John McPhee as he wrote his books on geology.[11] The "oil boom" of the 1970s and early 1980s gave me a chance to participate in the industry again. As a consultant, I advised programs that drilled for natural gas across western New York and northern Pennsylvania. My programs drilled 100 successful gas wells without a dry hole; one of them was the largest gas well in the history of New York State.[12] I also served as an expert witness in oil litigation.

You don't outgrow your roots. As I drive by those smelly refineries on the New Jersey Turnpike, I want to roll the windows down and inhale deeply. But in all the years that I worked in the petroleum industry, I never came to identify with the management. I'm a worker bee, not a drone.

A couple of years ago, I was testing a new treatment on an oil well in northern Pennsylvania. I picked up a pipe wrench with a 36-inch handle and helped revise the plumbing around the wellhead. I was home again; I loved it.