

Before the United States and Britain invaded Iraq in March 2003, their oil companies were shut out of oil-production contracts being negotiated by the government of Saddam Hussein. Today, more than six years of war later, Saddam is gone, and the U.S. and British oil companies are not only in on the oil contracts, they have managed to sweeten the terms... However, organized resistance by Iraqis and people around the world has thus far succeeded in denying Big Oil its Big Prize: passage of the Iraq Oil Law, alternatively called Iraq Hydrocarbons Law, which would grant far greater control over Iraqi oil to foreign companies on terms much less favorable to Iraq than the current contracts provide... If the negotiations proceed on their current path, foreign companies will produce the vast majority of Iraq's oil. How much control they will exert, and who will reap the greatest benefits (and endure the steepest costs) is yet to be determined.

Before the Invasion — In January 2000, 10 days into President George W. Bush's first term, representatives of the largest oil and energy companies joined the new administration to form the Cheney Energy Task Force. As part of its deliberations, the task force reviewed a series of lists titled "Foreign Suitors for Iraqi Oilfield Contracts" naming more than 60 companies from some 30 countries with contracts in various stages of negotiation... None of the contracts were with American or major British companies, and none could take effect while the U.N. Security Council sanctions against Iraq remained in place. Three countries held the largest contracts: China, Russia, and France — all members of the Security Council and all in a position to advocate for the end of sanctions. Were Saddam to remain in power and the sanctions to be removed, these contracts would take effect, and the U.S. and its closest ally would be shut out of Iraq's great oil bonanza.

After the Invasion — The invasion of Iraq dealt handily with the problem of U.S. and British exclusion. ExxonMobil, Chevron, BP, ConocoPhillips, and other major oil companies met with the Iraqi government on countless occasions, and the Iraqis tried to make deals... But the oil companies, backed aggressively by the Bush administration, steadfastly insisted that contracts would only be signed after the Iraq Oil Law was passed. They nearly prevailed on several occasions, but organized resistance in and outside of Iraq has continually stymied the law's passage.

Several forces have conspired to bring the oil companies to the negotiating table today. Most recently and significantly, Iraq's Parliament has refused to even consider the law until after the January 2010 elections. It is quite likely that a new government hostile to the interests of foreign (particularly U.S. and British) oil companies could come to power in those elections, making passage of the law much less likely. The deals being offered today would be the best the companies would be likely to get.

President Barack Obama and his administration have been vocal and active proponents of the law's passage; however, this administration's allegiance to the oil industry is not as steadfast as that of its predecessor... The Obama administration's push for passage of the law comes at the same time that it pursues withdrawal of all but a residual U.S. troop presence. It is hard to underestimate the added negotiating weight brought by 150,000 members of the U.S. (and until very recently British) military. Bush announced his most public declaration for passage of the Iraq Oil Law at the same time that he announced the surge of an additional 20,000 U.S. troops into Iraq. The pending loss of its most potent negotiating stick has clearly made the oil companies more willing to deal.

Secretary of State Hillary Rodham Clinton may have put forward the administration's best position at the U.S.-Iraq Business and Investment Conference on Oct. 20, explaining: "A comprehensive hydrocarbon law is vital for regulating the [Iraq] oil sector. Parliament has delayed this vote until after January, but steps can be taken in the interim; for example, by holding transparent, credible auctions on oil and gas fields as we are seeing ..." In other words, 'we know you want the law, but Parliament isn't biting, and we're not keeping 150,000 U.S. soldiers in Iraq indefinitely for you to get it. So, sign the d*** contracts.' — And finally, under immense pressure, the Iraqi Oil Ministry also has steadily been sweetening the deals...

The New Oil Contracts

The Iraq Oil Ministry began a bidding round in June for eight currently producing oil fields, which are among the largest in the world. Only one consortium — BP and the Chinese National Petroleum Corp. — agreed to the terms. The rest of the companies balked, saying the terms just simply were not generous enough. The terms have since been sweetened (and applied retroactively to BP and CNPC's deal), and the companies are now jumping on board.

Because the U.S. and British companies to a large degree have squeezed into pre-existing negotiations, some strange bedfellows have emerged to sign these new contracts, and more odd pairings are expected soon... * BP and CNPC finalized the first new oil contract issued by Baghdad for the largest oil field in the country, the 17-billion barrel Rumaila field.

* ExxonMobil, with junior partner Royal Dutch Shell, won a bidding war against Russia's Lukoil and junior partner ConocoPhillips for the 8.7 billion barrel West Qurna Phase 1 project.

* Italy's Eni SpA, with California's Occidental Petroleum and the Korea Gas Corp., was awarded Iraq's Zubair oil field with estimated reserves of 4.4 billion barrels.

* Japan's Nippon Corp., leading a consortium of Japanese companies including Inpex Corp. and JGC Corp., is at an advanced stage in talks to win the Nassiriyah oil field.

- Shell, with partners CNPC and the Turkish Petroleum Corp., is also in discussions for the giant Kirkuk oil field, although negotiations have been delayed until after Iraq's January elections.

The Terms

These contracts are complex and unique, representing a hybrid of existing models. They are not the best that the oil companies hoped for, which would have been production-sharing agreements (PSAs). Nor are they the worst the companies might have feared: Iraq is not maintaining its nationalized system, closed to foreign oil company production participation (U. S. and other foreign oil companies sell Iraqi oil now and have done so for decades).

They are also not technical service contracts (TSCs), although this is what the Iraqi Oil Ministry has named them (likely in an attempt to thwart opposition to the contracts for offering too much to foreign oil companies). Greg Muttitt, an Iraq oil expert with Platform, told me, "TSCs generally last just a few years. They're generally for a specific job (e.g. installing pumps) rather than managing a field, and they go to service companies like Baker Hughes and Halliburton."

On the positive side for the companies, where the development production contracts (DPC) that Iraq was signing prior to the 2003 invasion offered 12-year contracts, today's run for 20 to 25 years; and while as recently as a year ago the Iraqis offered the foreign companies a 50 percent ownership stake, today's contracts offer them a 75 percent stake (25 percent for the Iraqi government)... On the other hand, where the PSAs sought under the Iraq Oil Law would give the companies an equity stake and the ability to book the oil in the fields as their own, these contracts provide reimbursement fees for capital and operational expenses and a fixed fee per barrel of oil produced and deny the companies the ability to book reserves.

It remains unclear whether the foreign companies or the Iraqi government ultimately has production decision-making authority, and some of the benefits included in the contracts would be annulled if the Iraq Oil Law were passed, including requirements to hire and train Iraqi workers and the transfer of needed technology... Finally, the Iraqis apparently sweetened the deals further in the last few weeks by reducing the amount the foreign companies pay in taxes and allowing them to use private security forces to protect their facilities.

The Next Bidding Round

On Dec. 11 and 12, the second, much larger, bidding round will be launched in Baghdad. Forty-four international companies have been prequalified to bid on run for 11 groups of oil and gas fields in already producing and undiscovered fields. Negotiations will include the super giant Majnoon field, which Chevron and France's Total have teamed up to bid for... The contracts for these fields are expected to mirror those described above, but no "model contract" has been made publicly available.

Sunlight

The Iraq Oil Law has remained an elusive goal of the world's most powerful industry and governments, because a

In the days after the 9/11 attacks — much as in the days after Tim McVeigh blew up the Murrah Building — America had the sympathy of the world, and the police and intelligence agencies of even normally hostile nations offered to help us track down and bring to justice its perpetrators... Muslims all over the world were horrified at the actions of one of their own, a fundamentalist turned criminal and murderer... Mullah Omar of Afghanistan's Taliban first offered to arrest bin Laden and turn him over to us (Washington Post, Page 1, October 29, 2001, "Diplomats Met With Taliban On Bin Laden" by Ottaway and Stephens) and then made an explicit offer to arrest Bin Laden and try him for the crime of 9/11 (CNN, October 7, 2001, "US Rejects Taliban Offer To Try Bin Laden"; *The Guardian*, October 14, 2001, "Bush Rejects Taliban Offer To Hand Bin Laden Over")... It would have been so easy for Bush to accept Omar's offer, which had resulted, according to the Post, in over 20 diplomatic meetings and negotiations. The Justice Department could have arrested Bin Laden like they did McVeigh, helped the Taliban dismantle Bin Laden's training camps and track down their attendees and sponsors, and launch an international effort to disassemble and render impotent al-Qaeda... It probably could have been done in a year or less, given the intensity of the worldwide empathy for citizens of America and the many other nations whose people died in the World Trade Center. Over 5,000 American soldiers would still be alive, and tens of thousands would not have lost arms, legs, and eyes. Hundreds of thousands — possibly over a million — innocent Afghans and Iraqis would still be alive.

But Karl Rove knew that George W. Bush had a problem, and saw in bin Laden the solution, and didn't much give a damn what it would mean to American Muslims.

Bush had not defeated Al Gore fair and square and was seen by most Americans as a spoiler, an illegitimate leader. As soon as the details of his proposed "supply side" voodoo economics hit the press in the first months of his presidency, the markets went into a nosedive... And already there were stories circulating in the media of his cozy relationship with corrupt oil barons like Ken Lay and the secret energy meetings in the Spring of 2001 — before 9/11 — in which Cheney, Lay, and others in the oil industry were apparently carving up the oil fields of Iraq... Bush, in short, was seen as a buffoonish pretender, an ineffectual manager, and a sellout to big oil and other scandal-ridden industries. He was the butt of late-night jokes, a former college cheerleader, a "dry drunk" (except when tempted by beer and pretzels), an inside trader, a small man on the national and international stage.

George W. desperately needed his own Lex Luthor if he was to reinvent himself as Superman.

Rove and Bush realized that if they simply branded Bin Laden as the criminal thug that he was — the leader of an obscure Islamic mafia with fewer than 20,000 serious members — they wouldn't have the supervillain they needed for George W. Bush to be seen as a superhero. If Bush only authorized a police action, or cut a deal with Omar, he'd miss a golden opportunity to position himself as the Battle Commander of The War Against Evil Incarnate... And so began the building of the mythos. Osama as evil genius. Osama as worldwide mastermind. Even Osama as the antichrist (as General Boykin reminded us so candidly).

If the remnants of al-Qaeda tried to pull our strings by increasing "chatter" about particular flights, for example, the Bush White House hyper-reacted with many press conferences and televised appearances by Tom Ridge. Every action was trumpeted. Bush put "Terror Alerts" on the screens of TVs nationwide as often as possible. The constant drumbeat was that George The Good was battling the One True Dragon. And that Dragon was Islamic.

For George to remain SuperGeorge, Bin Laden had to be as big as Hitler in the minds of Americans. Thus, Richard Perle wrote in his breathless and hyperbolic book, "An End To Evil: 'There is no middle way for Americans. It is victory or holocaust' "... But Afghanistan and Iraq weren't Germany, and Bin Laden wasn't even a pale imitation of Hitler. It wasn't a nation that attacked us — it was a tiny, local, but well-funded Islamic mafia — and that band of thugs run by Bin Laden no more represented the interests or opinions of the majority of the world's Muslims than Tim McVeigh represented the majority of America's Christians.

This archetypal transformation of George W. Bush from spoiled, rich-boy pretender-to-the-presidency into the caped (well, flight-suited) SuperGeorge, Defender Of All Things Good And Right, had a powerful impact on the American people — and particularly on their perception of Muslims... The shadow of the "good" SuperGeorge was, necessarily, the "evil" of Muslims. They were vilified — talk show hosts called for their outright murder ("Kill them all" said Michael Savage) — and a steady drumbeat of suspicion was cast toward American Muslims... Fox News and right-wing talk jumped in with both feet, feeding anti-Muslim hysteria that continues to this day with teary-eyed TV shows, a "secret Muslim" president, and Nazi-image Tea Parties. "Be afraid," they tell Americans every day. "Be very afraid."

when his ideas could be properly investigated. That time seemed to come in the 1980s, when fractals and scale invariance hit the scientific big time. Simple scaling laws were suddenly claimed to underpin everything from the size and frequency of earthquakes and avalanches to the rise and fall of stock markets. So why didn't anyone put Richardson's idea to the test and search for simple power laws describing the entire atmosphere?

The problem, says Lovejoy, lies with the word "simple". When fractals began making headlines, researchers raced to find the power laws behind a host of natural phenomena. In particular, they sought the value of the "exponent" in these power laws, the one number that governed the extent to which the phenomenon in question changed with scale. (In the bathroom tile example, the exponent is 2.) ... But they soon ran into trouble. "They found that this single-exponent approach didn't always work," says Lovejoy. "Many phenomena failed to obey power laws with one exponent, and people started to give up on them, saying the idea was overly simplistic and had been oversold.".. Among the ideas abandoned was Richardson's claim that the atmosphere is ruled by power laws; but in their race to move on, many researchers had overlooked the possibility that describing the atmosphere might be a tad more complex than describing a coastline, and so might have needed a slightly more sophisticated approach... Take air pressure, for example. The familiar isobars on weather charts define regions of equal pressure, similar to the elevation contours on a map. Indeed, an isobar can be thought of as a kind of "coastline", described by its own fractal law, but there's a key difference: a coastline's shape is defined only at one specific value of height — sea level. In contrast, the isobars of air pressure form a whole array of shapes at different heights, like Russian dolls nested within each other. Air pressure is what mathematicians call a multifractal field, described by a whole set of power laws, rather than just one.

The failure of researchers to find simple power laws for the entire atmosphere says more about their naivety than about Richardson's idea, but it cast a long shadow over attempts to apply fractals to meteorology, as Lovejoy himself discovered early in his research [career](#). Inspired by the work of the French mathematician Benoit Mandelbrot, who coined the term "fractal" in the 1970s, Lovejoy devoted half of his doctoral thesis to evidence for power laws governing rainfall. "I was getting ready to move on to my postdoctoral research when I learned that my thesis had been rejected," he recalls. "The examiner couldn't see any connection between fractals and rainfall and I was advised to remove all references to it."

Not wanting to risk a final rejection, Lovejoy did as he was told and resolved to publish the excised findings. They appeared in *Science* in 1982 ([vol 216, p 185](#)), along with Lovejoy's tentative claim that they might just be linked to Richardson's outlandish idea.

In the following years, Lovejoy teamed up with [Daniel Schertzer](#), now at the University of Paris East, France, and set about searching for evidence for multifractal power laws lurking in weather data. They focused on rainfall: a meteorological phenomenon whose familiarity masks the complexity of its origins. Triggered by a delicate balance of atmospheric factors, rainfall is tough to model even using the most powerful supercomputers. Yet, by analysing data from the rain-detecting radar network around Montreal, Schertzer and Lovejoy found evidence for an underlying simplicity to the process... The radar data allowed them to plot the amount of rainfall in an area, as they zoomed in and out at different scales. The researchers found their plots could be described by power laws with different exponents — a strong hint that rainfall is a multifractal process, with the underlying physics cascading down to ever-smaller scales.

While intriguing, the discovery was far from compelling. For a start, the data only allowed Schertzer and Lovejoy to extract power laws spanning scales between about 100 kilometres and 1 kilometre. To properly support their theory that the atmosphere is multifractal, they would have to show the scaling laws still held out to scales of tens of thousands of kilometres — the size of the entire planet.

The team realised that one source of meteorological data was up to the [job](#): orbiting satellites. Scanning the planet evenly and in great detail, they build up a consistent picture at scales ranging from a few kilometres to the whole planet; and Schertzer and Lovejoy realised that a satellite launched in 1997 by NASA and the Japanese space agency JAXA could allow them to put the multifractal theory to a truly global test.

Orbiting the planet every 90 minutes, the [Tropical Rainfall Measuring Mission \(TRMM\)](#) peers down on a broad swathe of Earth with sensors that detect the telltale signs of rainfall on scales down to a few kilometres. Together with their colleagues at McGill University and the University of Paris East, Schertzer and Lovejoy analysed 1,200 consecutive orbits of TRMM, looking for signs of multifractal behaviour in the atmosphere.

Earlier this year, they published their findings in *Geophysical Research Letters* ([vol 36, p L01801](#)), and they were simply stunning. The satellite data generated a beautiful collection of fractals and followed power laws on scales from tens of thousands of kilometres down to about 10 kilometres.

Going off grid

Today's computer models represent the atmosphere as a vast grid-like pattern of cells, whose meteorological properties are calculated using the complex equations formulated by Richardson and his successors. The finer the grid, the better the simulation, but even the world's fastest supercomputers can't cope when the grid is made up of cells smaller than about 100 square kilometres... To get around the problem, modellers have come up with estimates of what happens inside the cells, called parameterisations. The problem with such parameterisations is that they can fall victim to the notorious butterfly effect, by which even small inaccuracies in the initial conditions can be magnified to huge size by the nonlinear nature of the processes underlying the weather. This can lead to unreliable forecasts.

McKenna believes that the discovery of scaling laws could transform the situation by providing insights into phenomena that take place on scales smaller than 100 kilometres. Robin Hogan of the University of Reading, UK, agrees that they could be a big improvement on existing techniques. "Although we won't know what individual eddies are doing at this sub-grid scale, their net ability to, say, transport heat vertically could be estimated," he says.

Now, Lovejoy's team is keen to see cascades extend the reach and reliability of current models. While the existing models cannot handle structures much smaller than 100 kilometres across, the cascades may continue down to scales smaller than a millimetre. "Cascades could help fill in that missing factor of 100 million or so," says Lovejoy... To find out, he and his colleagues are now working with researchers at the US [National Oceanic and Atmospheric Administration](#) in Boulder, Colorado, on incorporating multifractal techniques into live computer models of the atmosphere. Their aim is to make both weather and climate models reliable at the finest scales possible. It's a challenging goal, but one that Lovejoy believes is achievable. "Obviously there are many issues to be resolved," he cautions, "and it may be some years before the techniques are implemented"... Nevertheless, it seems we are closing in on a new era in our understanding of the atmosphere, one in which computer models finally get to grips with its full complexity in all its beautiful simplicity, and with the need for reliable predictions of the future climate more pressing than ever, Richardson's genius may have cut through the clouds of complexity in the nick of time.

"The history of science shows that complex phenomena usually give way to underlying simplicity," says Lovejoy. "And simplicity points the way to the future".

A reality check for climate models

It's not just more reliable weather forecasts we can expect by swapping complex numerical models for the simpler ones advocated by British mathematician Lewis Fry Richardson. [Robin Hogan at the University of Reading](#), UK, believes that such power laws could also act as a vital reality check on climate models. Put simply, if a given model doesn't reproduce the real atmosphere's multifractal behaviour and its power laws, something must be missing... Which raises an obvious question: how well do current models of the atmosphere perform? After all, if there's any truth in Richardson's idea, their computational complexity should give rise to cascading simplicity. Jonathan Stolle at McGill University in Montreal, Canada, has teamed up with his colleague Shaun Lovejoy, and David Schertzer at the University of Paris East, France, to examine this issue, and so far the results are encouraging.

"We've recently demonstrated that the top traditional numerical models have virtually perfect cascade structures from around 10,000 kilometres down to 100 kilometres," says Lovejoy. Power laws may be able to extend the models' reach and accuracy even further.