

TRUST AND TERROR: The Vulnerability of Complex Socio-technical Systems

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A defining characteristic of contemporary civilization is how thoroughly life depends on the structure and proper functioning of numerous large-scale, complex artificial systems. Indeed our current way of living would be unthinkable were it not for powerful technologies in energy, transportation, communication, medicine, computing, water supply, food production, industrial production, and the like. So dependent have we become upon such things, so much are they part of our reality, that their presence is simply assumed, seldom questioned.

For countries in the North, such dependency is welcomed with open arms because it seems crucial to prosperity and freedom. Large-scale, geographically extended technologies enable us to move about as we wish, to communicate freely and to be released from the urgent demands of day-to-day survival that confronted previous generations and that still threaten less prosperous nations around the globe.

But now another, more troubling dimension of technological complexity demands attention. Dependency on complex technological systems looms as a source of vulnerability. If any major component within the systems that support modern life ceases to function for a significant period of time, our prosperity, freedom and comfortable lives are threatened.

This was a matter of widespread public concern in 1999, as people agonized about the possibly disastrous system collapse that might be caused by the Y2K programming. Many were alarmed that the energy grid, airline transportation, banking system, and other systems would be disrupted by computer malfunctions, plunging society into chaos. It turned out that despite minor glitches here and

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there, the predicted Y2K chaos never arrived. But during the last months of 1999, perceptions of vulnerability bordered on mass hysteria, so much so that the opportunity for reflection on the grand significance of moving from one millennium to another was simply put aside. Instead of asking what the new epoch might bring, people obsessed, ‘Oh dear, what will happen if I can’t access my automated teller on January first?’

■ **RESPONSES TO VULNERABILITY**

There are several ways that our society routinely deals with the spectre of vulnerability. One strategy is to ensure that technical devices and systems are well engineered, protected from calamitous failure. Engineers and systems designers make sure that structural parts can hold an increment more than the normal loads they must support. Redundancies are also built into many systems so that if one part fails, another part takes over (cf. Pool, 1997, chs 4–5).

But good engineering is only part of the story. In free, democratic societies there is another way in which ordinary people have managed their relationship to vulnerability—embracing an *attitude of trust*, holding on to the reasonable expectation that key technologies will always work reliably and not break down in ways that jeopardize our health, safety and comfort. This relationship is reciprocal; an understanding of trust informs the structure and operation of technological systems themselves.

Many key components are built in ways that leave them open to the possibility of inadvertent or deliberate interference. Electrical power lines, phone lines, gas pipelines, dams, aqueducts, railroads, airplanes, elaborate works of architecture, and the like are often more or less naked to the world, open to view, minimally guarded from the kinds of interference that could render them inoperable. For many decades a common but largely unspoken expectation has been that people in prosperous industrial societies can be trusted not to act in ways that would disrupt or destroy the workings of the key parts of the technological order.

Most people accept the presence of major complex technologies because their well-being hinges on them, because there’s no good reason to act destructively and, of course, because the law punishes overt acts of sabotage. Exceptions include occasional bombings by

anarchists in the early twentieth century, acts of destruction by the Weathermen and political extremists in more recent times, Timothy McVeigh and the Unabomber among others. But for the most part, the relationship of openness and trust between individuals and complex systems has proven fairly resilient.

A much different understanding of how to manage large, complex systems characterizes closed, guarded, totalitarian societies, the Soviet Union under Joseph Stalin and Kim Il-sung's North Korea, for example. Regimes of this stripe have hardened the design of their technologies and installed vast systems of policing and surveillance because they did not trust their own people. For any society that adopts strategies of this kind—pervasive suspicion and obsessive protection of core technologies—an inevitable consequence is the destruction of civil freedom.

What would happen to our own society if the long-standing conventions of openness and trust were suddenly afflicted by a pervasive sense of vulnerability and dread? Would our rights, liberties and democratic institutions survive?

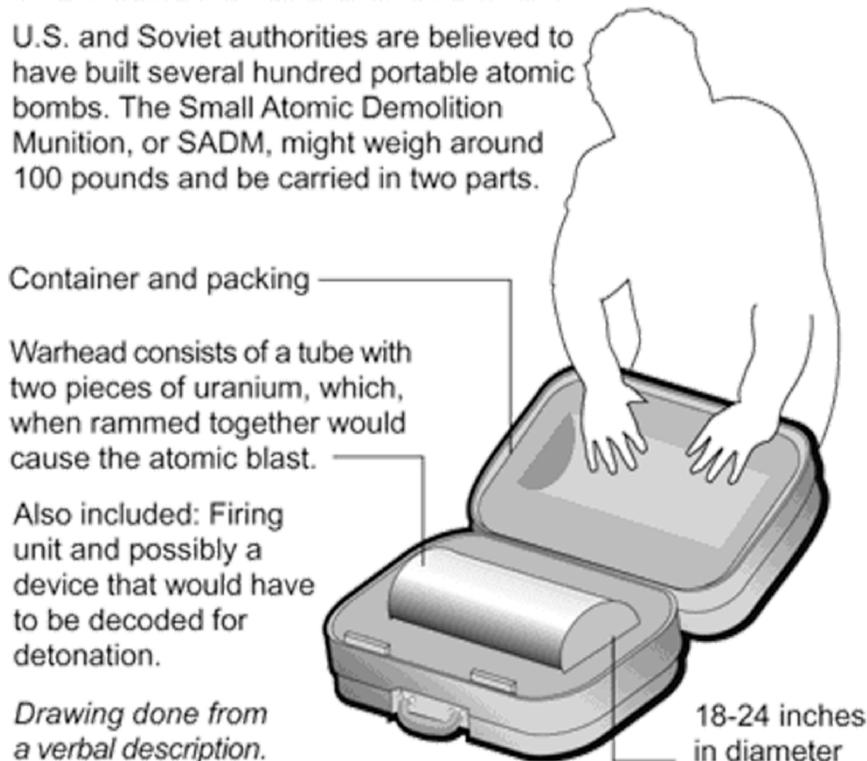
■ VEHICLES FOR DESTRUCTION

In the aftermath of the attacks upon the World Trade Centre and the Pentagon along with the anthrax scares of autumn 2001, such questions have renewed urgency. Americans are now profoundly aware of their vulnerability. Noticing the dams, reservoirs, bridges, power plants, chemical plants, aqueducts, electrical transmission lines, liquid natural gas tankers, even the daily mail and systems of food supply—all of them seem wide open to attack.

As far as I can tell, both the planes that left Boston on September 11 on the way to the twin towers of the World Trade Centre flew right over my house in the Hudson River Valley. If the pilots had wanted to do maximum damage to the region, a far better target would have been the nuclear reactors at the Indian Point electrical power plant about 60 miles south. Since these facilities were not designed to withstand a direct hit by an airliner, targeting them might have caused catastrophic failure, and possibly a core melt down as the fuel sank into the mud and water of the Hudson River. The resulting plume of radioactive steam and debris would have killed tens of thousands very quickly and rendered much of the

Portable destruction

U.S. and Soviet authorities are believed to have built several hundred portable atomic bombs. The Small Atomic Demolition Munition, or SADM, might weigh around 100 pounds and be carried in two parts.



Destructive power of the SADM

- SADM: Equivalent to 1 kilotons or less of TNT
 - Hiroshima bomb: 13 kilotons

SOURCES: Federation of American Scientists; Monterey Institute of International Affairs; Natural Resources Defense Council

AP

Portable Destruction-

Credit: Federation of American Scientists

Northeast uninhabitable for thousands of years. We are lucky that the al-Qaeda terrorists were so obsessed with the symbolic value of the World Trade Centre that they neglected what may have been more destructive targets, America's 103 nuclear power plants.

Within the collection of infrastructures upon which we depend, there are many others that are essentially wide open, loosely pro-



Container Ship.

tected. The nation's containerized cargo system provides a good example. Each year some six million sealed containers arrive from all around the world. At the time of the 9/11 attack only 2% of these were ever inspected, although measures since then aim to increase that percentage (Bayles, 2002). If anyone had the ability to make or purchase a nuclear device or dirty bomb, a convenient way to deliver it would be to ship it by containerized freighter and at the appointed moment, set it off. A recurring nightmare: one morning we turn on our televisions to find that San Francisco, San Pedro or New York have been levelled by a nuclear blast from a weapon hidden in one of those large steel crates.

There are many other horrifying scenarios, of course. If anyone had the desire to use it, a readily available, flexible delivery system for maximum destruction is the automobile, a fact all-too-clear in Ireland, England and the Middle East in recent decades. There are now some 230 million registered cars and trucks in the USA. The Oklahoma City bombing demonstrated how easy it is in an open society to fill a rental truck with explosives made of readily available

chemical fertilizers and set it off in the middle of town. Just as we previously had not thought about commercial airliners as flying bombs, Americans do not regard their beloved automobiles as flexible, ubiquitous instruments of destruction, although they sometimes serve that role in the Middle East and other troubled regions of the world.

Recognition of the vulnerability of open, complex, geographically extended, technological systems is by no means new. In 537 A.D., the Gothic chieftain Vitiges and his forces laid siege to Rome. A crucial part of Vitiges strategy was to cut the aqueducts leading to the city, forcing the Romans to rely on the inadequate stream of water from the Tiber River. As a result, the population fled Rome in droves, as much in response to water shortage as to flee the sack of the city. Of course, scholars have long debated the events and underlying troubles that brought about the fall of Rome. The Visigoths had sacked the city as early as 410 A.D. and sixth century attempts to restore Rome's power had failed miserably. But as geographer Gray Brechin observes in *Imperial San Francisco*, 'the destruction of the aqueducts conclusively ended the rule of a city that had once boasted of itself as the *caput mundi*—the world's capital' (1999, p. 73).

■ THE WITHDRAWAL OF TRUST

Following the atrocities of September 11, the world's current *caput mundi*, the United States, has struggled to find ways to confront revelations of its own vulnerability. To this point most of the emphasis has centred on a rapid shift from trust to mistrust, installing muscular socio-technical fixes that promise security against terrorism and place its whole population under suspicion.

Most prominent of proposed remedies is the USA-PATRIOT Act: 'Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism'. This astonishing piece of legislation broadens and extends the government's power to listen in on private conversations including cell phone conversations nation wide; authorizes surveillance of email, web browsing and other Internet communications and allows police to obtain a warrant to search a person's home without the person's knowledge.¹

Other steps in this vein include changes in America's immigration rules that allow the Attorney General to keep foreigners in detention even though an immigration judge orders them released. President George W. Bush issued an executive order aimed at creating special military tribunals for foreign nationals suspected of terrorist acts, courts that lack many of the protections afforded by our laws and Constitution. Along this path hundreds of Muslim and Arab persons have been detained before being charged with a crime or breach of immigration status, in direct contradiction to the US Constitution. Even now, more than two years after the attack, it is difficult to obtain the names of those being held or information about the charges lodged against them.²

As the shadow of secrecy and suspicion has fallen across the land, useful government information about the nation's technological infrastructure—websites on water systems, nuclear power plants, chemical plants and the like—have been removed or are severely restricted in content. For scholars, it is now much more difficult to study what used to be regarded as a perfectly mundane question: the structure and operation of technological systems. What used to be public information freely available to citizens, is now regarded as crucial national 'intelligence' to be shielded from the grasp of spies and saboteurs.

The wave of new Federal legislation and regulation is now mirrored in a host of anti-terrorist laws passed by state legislatures, ones that feature strengthening the power of police to monitor the activities of citizens who for one reason or another must be watched. In this new mood, the definition of terrorist activity is sometimes so broad and vague that it casts a shadow over a wide range of political activities, organizing public protest marches, for example. Civil liberties groups are concerned that ordinary forms of political protest could be defined as terrorist and suppressed. This might include, for instance, the public gatherings to protest globalization like those in Seattle and other cities in recent years. Unfortunately, episodes of political repression during times of civic distress—the Palmer raids after World War I, the incarceration of American citizens of Japanese decent during World War II, the malicious persecution of dissidents during the McCarthy era of the 1950s, etc.—are all-too-common in American history. When the nation feels threatened, freedom takes a beating (Donner, 1980).

■ A CHILL IN PUBLIC LIFE

On radio and television talk shows and in newspaper editorials since the 9/11 attack there has been a strong tendency to define terrorism in broad, loose, inflammatory terms. The same penchant also afflicts lawmakers at all levels. Last spring the Maryland House of Delegates passed an anti-terrorism law extensive in its sweep. Dana Lee Dembrow of the Maryland House of Delegates observed 'I realize that this bill basically says you can tap someone's phone for jaywalking, and normally I would say, "No way", ... But after what happened on September 11, I say screw em' (Mosk, 2002).

The nation's obsession with security now casts a chill upon public life and the only question is 'How cold will it get?' For example, since the 1960s there has been a lively debate about privacy and personal liberty in the age of electronic data. A rough consensus formed that citizens ought to be free from the snooping of government, corporations, and private individuals. That consensus has now been demolished by the belief that widespread surveillance is necessary and that ingenious systems like the FBI's Carnivore (which can monitor everyone's email and Internet activities) are exactly what is needed to defend the country.

Within post-9/11 security measures protections of the US Constitution have been seriously weakened. Thus, the Fourth Amendment insists, 'The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no warrants shall issue, but upon probable cause, supported by oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized'. But under provisions of the USA-PATRIOT Act, authorities can now search everywhere, indefinitely, online and off, with one general warrant.

A draft of a proposed law, 'Domestic Security Enhancement Act of 2003', leaked from the Justice Department and sometimes called Patriot II, promises even more pungent measures to stifle the kinds of rights and freedoms that might be abused to further terrorist projects or, perhaps more ominously, to seek information about government policies or to criticize political leaders. One section of the proposed bill stipulates that 'joining or serving in, or providing material support ... to, a terrorist organization shall be *prima facie* evidence that the act was done with the intention of relinquishing

United States nationality'.³ Thus, making a speech, signing a petition, donating money, or otherwise acting in support of a cause the Attorney General designates 'terrorist' would result in the revocation of citizenship with all its rights and liberties.

Such draconian legislation is perhaps just one large, dramatic domestic bomb blast away from being approved by America's increasingly spineless Congress. In fact, pieces of the widely despised Patriot II have already become law, included as stealthy 'riders' within pieces of legislation drafted by Republican officials (Smith, 2004). Steps of this kind mirror the Alien and Sedition Acts that nearly tore the American Republic apart in its early years as well as the dark days of 1950s McCarthyism in which whole domains of free speech, free press and free assembly were suspended in the name of 'anticommunism'.

There is, alas, already widespread spillover of 'anti-terrorist' sentiments into civil society as a whole. Hoping to deflect suspicion, many Americans have become guarded and self-censoring. In the two years following 9/11, it was not uncommon to hear people say, 'No, I don't worry about ant-terrorist legislation. I'd never do anything the authorities would be interested in anyway'. Evidently, patriotism requires us to be perfectly compliant and predictable.

Typical of the mood of panic just after the 9/11 attacks there was a news segment on National Public Radio that asked security experts about everyday vigilance against terrorism. What should ordinary folks watch out for? 'Look for any signs of "unusual" behavior', one expert advised. This would include people wearing clothing that seems out of place, or saying things or making gestures that were not appropriate for a particular place or occasion. As I listened to the story, it struck me that what were identified as dangerous 'unusual behaviors' were simply varieties of freedom—wearing what we like, saying what comes to mind, acting freely in public. Expressions of this kind need to be reported to the authorities immediately.

■ WHEN STABLE STRUCTURES DISSOLVE

We cannot know the specific intentions of the September 11 terrorists. But if one of their aims was to render our way of life much less open and free, they have succeeded beyond their wildest dreams. As if responding to their own version of the Reichstag Fire in Berlin

1933, Americans are busy restricting freedom of travel, limiting access to information, narrowing the boundaries of political speech, rounding up foreigners, and pruning away what were once regarded as crucial branches on the tree of liberty. One ingenious programme, the Department of Justice 'Terrorist Information Protection System' (TIPS), reminiscent of notoriously repressive measures in the USSR and other totalitarian societies, sought to enlist one million mail carriers, truckers, train conductors, and other workers to act against the citizenry. After howls of public protest, however, Congress eventually withdrew funding for the scheme.

Undaunted by occasional setbacks, the Bush Administration has moved forward with ingenious methods of surveillance, especially ones realized in complex information systems using software for massive data mining. The USA-PATRIOT Act created a 'Directorate for Information Analysis and Infrastructure Protection', authorized to collect and analyze an unlimited range of data from government, corporate and personal records, including one's email and Internet browsing. Also established by the Act is the Homeland Security Advanced Research Projects Agency that promises to advance the state of the art in paranoid technological innovation to unprecedented levels, linking a wide range of public and private databases in medicine, employment, education, crime, and the like.

A well-funded test of the new data gathering methods was launched at the Pentagon in the spring of 2003. Originally named the Total Information Awareness System, later changed to the seemingly more palatable 'Terrorist Information Awareness System', the organization deliberately seeks to construct the all-seeing electronic Panopticon long feared by lovers of human freedom (Markoff and Schwartz, 2002). The original manger of the Total(-itarian?) and/or Terrorist Awareness Information System was none other than retired admiral John Poindexter, a shadowy figure who destroyed official documents, obstructed Congressional inquiries and was convicted of five felonies (later overturned on appeal) during the Iran-Contra scandal of the late 1990s. In the summer of 2003 as the public became aware of another of his bizarre innovations, a Pentagon operated terrorist 'futures market', Poindexter was forced to resign (Graham, 2003).

Supporters of anti-terrorism measures assure the public that the new tools will not be used to curtail the rights and freedoms of

citizens. But there have already been cases of police snooping under the Patriot Act in matters that clearly have no connection to terrorism at all. Thus, public officials in Las Vegas were the targets of an FBI investigation of corruption involving a local strip club. Increasingly aware of actual and potential excesses of this kind, a growing (but still small) portion of the American populace has begun voicing opposition to the spread of anti-terrorist intrusions into everyday life. Some 246 towns and cities, including New York, have passed resolutions demanding the repeal or thorough modification of the Patriot Act (Garcia, 2004).

While the ultimate outcome is far from certain, the overall drift of events is entirely clear. Many government officials and ordinary folks are modifying social life in ways that define people as suspects rather than citizens. In deliberations about public policy (regardless of topic) terrorism and security have become the overriding concerns. Organizations and individuals seeking support for their projects these days often find it prudent to justify programmes in terms of their promised contribution to the war on terrorism. For example, university colleagues of mine who once prided themselves on training computers to write (bad) short stories, have now turned their attention to writing artificial intelligence programs that survey textual data in the hope of giving advance warning of possible terrorist tendencies. Evidently, there are no horrors so dreadful that they cannot be transformed into fascinating topics for ‘cutting edge’ research.

In much the same way that sixth century Romans abandoned their city when the aqueducts were cut, Americans seem to be abandoning essential parts of the democratic civic culture that had developed during the past two centuries. This appalling turn of events is certainly evident in the material features of public buildings and grounds. A visit to Washington, DC shows the place transformed by ever-present ugly cement barriers, recurring security searches and ubiquitous surveillance cameras. Avenger anti-aircraft missiles have been installed near the Washington Monument to guard against airborne attack. The city has been redesigned as the capital of Homeland, a strange new country where once cherished freedoms of thought, expression and movement are regarded as luxuries too dangerous to afford.

In the current mood, people view terror as something that has

suddenly arrived from outside, inflicted upon an otherwise contented, harmonious society by ‘evil doers’ from distant parts of the world. Obviously, there is much truth in that view. There are malevolent actors out there prepared to inflict death and destruction on innocent civilians.

But seen from another vantage point, the terror we experience—the dread that now afflicts everyday life—resides in the very systems we have so ingeniously built during the past century. Modern, complex technologies succeed by wresting enormous stores of power from the natural realm, seeking to direct these powers in ways that are controllable and useful. An unhappy possibility can never be entirely eliminated, however, the prospect that these enormous forces will somehow be unleashed uncontrollably from systems and infrastructures originally built to contain them.

In recent years, fears of this kind have focused on rare technological accidents, the explosions of the Challenger and Columbia space shuttles, for instance. Such misgivings also underscore contemporary evidence about environmental ills, including global warming. Our technology’s controlled use of fossil fuels over many decades has generated uncontrollable, highly destructive shifts in climate.

Following the 9/11 attack, the horizons of catastrophe have shifted. For example, the accomplishment of a jet airline is to contain and direct the high energy fuel whose combustion enables rapid flight; the achievement in the engineering of skyscrapers is to defy gravity by ingeniously stacking tons upon tons of steel and other materials in high structures so that—despite their obviously precarious position—they will not fall down. But what if these powers were released in ways not part of the original blueprint?

The horror of the World Trade Centre attack was that the power of two wonders of modern technology—the skyscraper and the jet airliner—came crashing together causing the carefully contained power of both systems to be released in catastrophic explosion, inferno and collapse. In this light, the ingenuity of the terrorists is to trigger processes that cause stable structures to dissolve. Indeed, if the al-Qaeda and other terrorists were truly clever, they might read the extensive literature on the material and social infrastructures of technology produced by scholars in science and technology studies in recent years. They would discover a wealth of information about the

social construction of highly vulnerable systems, knowledge that could easily be transformed into a map of possible targets.

Deeply buried in our experience of modern technology is the elementary terror that powers we sought to control will escape our command and come back to injure or destroy us. Perceptions of this kind have surfaced in countless science fiction novels and cinema of the past century, turning our worst fears into mass entertainment. But beyond the paperbacks and movie screens an urgent question now beckons. How many systems of megatechnical power can one introduce before they begin to overwhelm the culture of democracy? As we construct complex, tightly coupled, geographically extended, powerful, but ultimately precarious systems, one result is a world filled with ticking time bombs waiting to go off.

Although seldom mentioned in the mass media, the ultimate fear driving public and private policies in the post-9/11 era, is an awareness that seemingly secure, reliable structures of contemporary civilization are, taken together, an elaborate house of cards. The collapse of the Twin Towers foreshadows other techno-social disasters too numerous to list, and perhaps the collapse of society as a whole, possibilities that now seem to justify the most urgent, ultimately violent measures.

America's knee jerk response to this terror at present is the familiar strategy of hardening systems to prevent disruption. The country is building new barriers around crucial systems, strengthening their internal components, surrounding them with elaborate methods of policing and surveillance. If it continues, this strategy of hardening technological systems will be a major drain on our economic resources and a hazard to both freedom and civility. But for the time being, the nation and its leaders seem prepared to pay these costs, even though they will rapidly degrade our institutions—schools further starved of funds and commitment, for example—weakening the fabric of democratic sociability.

■ A FORTRESS MENTALITY

It is far from clear that the new measures will succeed in reducing society's vulnerability to terrorist attacks. A study by the Department of Transportation released in spring 2002 found that in attempts to smuggle weapons through newly bolstered airport security gates,

30% of the guns and 70% of the knives were missed by the guards and scanning devices. Similar tests of security at nuclear power plants produced similar results; breaching the barriers around these facilities seems to be fairly easy. Even after the installation of costly, scrupulously organized systems of airline security, it was possible for Nathan Heatwole, an American college student, to smuggle box cutters and other banned devices aboard several commercial flights. Heatwole's email message to Federal authorities explained that this was an 'act of civil disobedience with the aim of improving public safety for the air-travelling public' (Anderson, 2003). Arrested and charged with several felonies, Heatwole faces many years in prison.⁴

The human demands of policing complex systems are, over long periods of time, probably beyond people's ability to bear. One episode just after 9/11 identified the Golden Gate Bridge as a likely terrorist target. Passage over the bridge was closed for a while and then National Guard troops were brought in to screen the traffic. Television coverage of the emergency showed exactly what one would expect, guardsmen standing around, bored, shooting the breeze, not paying attention to the vehicles going past. And this was a nationwide terrorism alert at the highest, most visible level!

Faced with shortcomings of this kind there are calls to redouble our efforts—spending even more money, installing more sophisticated equipment, hiring more security personnel, subjecting the public to spiralling levels of hassle, search, surveillance and mistrust. Alas, those in the political opposition, the Democrats, find it to their advantage to lead the charge, claiming that the Republican Administration has actually been lax in implementing urgently needed security measures and that much more money for anti-terrorist programmes is needed, even though that would clearly drain funds from the social programmes that Democrats traditionally support. Thus, the prevailing climate of fear has neutralized the ability to criticize dominant strands of policy or to imagine alternatives, not only as regards 'Homeland security', but in all domains of public policy.

There is, to be sure, much sheer opportunism in the 'war against terror'. The Bush Administration has been adept in manipulating the climate of fear to weaken environmental standards, dismantle public education, boost the interests of the oil lobby, and redistribute burdens of taxation and debt in ways that favour the wealthy over the

**Colour-Coded Terror.**

Credit: Dept. of Homeland Security.

poor and middle class. Indeed, the institutions of liberal democratic society—once believed crucial to ‘life, liberty and the pursuit of happiness’—have been quickly redefined as a vast protection racket whose ostensible purpose is the defence of technological infrastruc-

tures but whose underlying aim is the creation of a hard-nosed ‘conservative’ capitalist regime.

Most remarkable in this transformation is that many of those who previously resisted its coming, now feel compelled (evidently heeding the most craven Hobbesian fears) to remain silent when faced with an increasingly regressive, oppressive state. Political leaders of all parties are heard to say, ‘You must understand that the world changed on September 11’, and then to give a list of the deplorable conditions that have now become features of everyday life. Our Reichstag moment continues indefinitely.

An impartial observer looking at the country from afar might be puzzled by how quickly and thoroughly these developments have modified the American way of life. Why didn’t the nation explore more fruitful ways of responding to the terror people feel? Why didn’t Americans try harder to preserve their traditions of openness, trust and freedom?

In the quest of security against ‘terror’ the USA has gone to war against Afghanistan and Iraq and is preparing to attack other nations said to belong to an ‘axis of evil’. The underlying premise is that the American government is justified in raining destruction upon distant populations, including innocent people, because such violence destroys terrorism at its roots rather than wait passively for ‘evil-doers’ to strike the Homeland again. This conveniently defines terror as something ‘out there’ rather than acknowledge some of its foundations in here, within the very frameworks that support our way of living, a high tech, highly dependent way of living. Almost none of the voices commenting on the ‘war on terrorism’, including those highly critical of George W. Bush’s bellicose policies, have wanted to examine the deep-seated sources of today’s vulnerability, including deeply entrenched circumstances of our own making.

■ TOWARDS MORE FORGIVING SYSTEMS

In my view, there are far better ways of responding to 9/11 than the knee jerk militarism, Orwellian surveillance and pre-emptive strikes on human rights that our leaders currently prefer. Urgently needed are measures that would address the sources insecurity and terror found at the very roots of modern civilization. Hence, it seems wise to design technical systems that are loosely coupled and forgiving, struc-

tured in ways that make disruptions easily borne, quickly repaired. Certainly it makes sense to rely upon locally available, renewable energy and material resources, rather than foster dependency on global supplies always at risk. It seems sane to rely on technologies operated by people in local communities who we get to know in a variety of roles and settings, not just as technical functionaries.

It seems reasonable to declare immediate ceasefire on crucial features of Earth's biosphere—the world's nearly exhausted oceans, for example—that we routinely assault in the name of industrial production. As a general matter, it seems high time to begin reducing our dependence upon overwhelming, risk-laden powers wrested from nature. Now we know: these powers threaten to destroy not only fragile ecosystems, but the habitats of freedom as well.

Fortunately, the richness of human knowledge includes workable systems alternative to today's artificially complex, power-centred, globally extended, increasingly war-hungry dinosaurs. The construction of more peaceful, resilient, loosely coupled systems can be accomplished through imaginative efforts (many of them well underway) aimed at living lightly on the earth with justice and compassion. Many examples are evident in today's efforts to achieve an ecologically sustainable economy based upon 'green design' in energy, architecture, transit, communications, agriculture, and industry.

Taken together, they offer more promising varieties of complexity, ones no longer predicated upon the domination of nature or of human beings. The generous spread of works of this kind for the benefit of all of the world's populace offers our best hope of eliminating the social and economic grievances that serve as spawning grounds for terrorist attacks. The challenge is for citizens, educators, business people, policy makers, civic leaders, as well as scientists and engineers, to face squarely the terrible violence that infuses 'our way of life' and to seek workable alternatives.

As the present atmosphere of hysteria, acquiescence and political opportunism subsides—and I believe it eventually will—we must renew efforts to build institutions and technologies that merit our trust rather than continually fuel our deepest fears.

NOTES

1. It is worth noting that during the 1990s a militant, far right wing, occasionally terrorist groundswell, the 'Patriot movement', arose in the American heartland.
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The Bush Administration choice of the term 'PATRIOT' for legislation to limit the liberties of citizens seems to pay homage to this segment of the Republican Party's political base.

2. Typical of the widespread crackdown on immigrants of Middle Eastern descent is the story of Ansar Mahmood, a Pakistani citizen living and working as a pizza delivery man in Hudson, New York. Mr Mahmood made the mistake of asking a guard at the local reservoir to take his photograph with the lake in the background and was arrested for suspicious behavior. Later charged and convicted of minor violations of immigration law, he is (at this writing) now subject to deportation, a step strongly protested by many citizens in upstate New York (see Elan, 2003).

3. The draft text of the proposed law can be found at: http://www.eff.org/Censorship/Terrorism_militias/patriot2draft.html.

4. A more intelligent response, in my view, would be to award Mr Heatwole a Presidential Medal of Honor and a long term research grant in the 'Social Deconstruction of Technology'. His peaceful inquiries revealed holes in airport security systems that skilled professionals using hundreds of millions of dollars and the latest electronics failed to identify.

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