

**TERRORISM, TECHNOLOGY, AND THE  
SOCIOECONOMICS OF DEATH**

**BY**

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# Terrorism, Technology, and the Socioeconomics of Death

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*Warfare, as an organized endeavor, is facing a paradigmatic shift. Throughout most of history, only states could effectively muster the capacity to kill an enemy in significant numbers. The weakness of the nation-state and the increasing permeability of borders are reducing the effectiveness of the state and increasing the role of non-state actors. Concurrently, the increasingly cheap availability of technical information and dual-use material is making mass killing possible for small groups, or even for individuals. Biological weapons, with their easy accessibility, lack of effective international controls, and disproportionately large effectiveness, offer a singularly attractive mix to radical groups. Due to these changing circumstances, the use of biological weapons as a terror weapon should be seen as an inevitability. The United States must radically rethink how it hopes to deal with biological warfare initiated by terrorists and fringe groups, given the likely ineffectiveness of current policies.*

## The Present Danger

Humans are creatures of habit. Furthermore, even when confronted with reasonably documented new facts that they understand intellectually, they frequently fail to grasp the new message at the visceral level. The opportunities for mass destruction and “Armageddon on the cheap” have proliferated. Communication and new means of transportation essentially have wiped out the comforts of international isolation. Geography still matters, but it no longer provides a safe haven for any state.

The computer and communications revolution by any measure we wish to cook up, has been taking place at a growth rate of somewhere between 15% and 30% compound for at least the past 30 years. The biotechnology revolution is just beginning and probably will show an even faster growth rate. The implications of these developments, both for the flourishing of civilization and its destruction by means unheard of as early as 30 years ago, are nothing short of staggering.

Many of the features characteristic of the nationstate of the late nineteenth and early twentieth centuries are becoming obsolete. In particular, borders are highly permeable to individuals, weapons and communication. Changes in technology are intimately intertwined with fundamental changes in the organization and attitudes of society. Transnational firms, associations, and trade patterns are crossing national boundaries with increasing frequency. The intense nationalism and isolationism of pre-World War II is

giving way to countries with many small special interest groups, a number of which are well organized with close international connections and may share values far different from the country as a whole. The potential lethality of small, organized, reasonably well-financed groups, be they inside or outside of the country, has been changing by orders of magnitude in the past few decades. The clearly defined concept of deterrence by a large power, if not completely dead, is dying fast for several reasons. There is no longer even an approximately politically bipolar world. Furthermore, the size of the group needed to become an organized agency of mass destruction is fast shrinking to a handful of individuals, less in number than most terrorist organizations.

The amazing feature of today's world is not how bad matters appear to be, but how good they are. With the vast changes that have taken place, the puzzle is why there have not been a far larger series of terrorist created disasters. The *Economist* (February 3, 1996) presented a graph indicating annual deaths from international terrorism in the past 20 years as fluctuating between 200 and 800 which, in contrast with a Bosnia or Rwanda, is minuscule. Is there some deep implicit set of inhibitions in the human species which keeps it from annihilating itself, or has it just been another instance of plain luck, where the dice have continued to produce apparently improbable rolls?

### **Open Discussion and Taboos**

Prior to writing an article such as this, which deals with some extremely unpleasant topics, several basic and hard to answer questions must be considered. The first is, do we perceive the presence of a qualitatively new danger to our society? The answer clearly is yes. The second question is, is it more or less helpful to write openly about this topic and risk the possibility that it actually might receive public attention of a perverse nature which could hasten the occurrence of the very events we are trying to avoid?

I believe that it is desirable to increase the level of open debate. Give the permeability of communications systems and the nature of modern television and other news media, which treat events such as the Persian Gulf War as though they were baseball playoff games designed more for the convenience of spectators than as a part of history, sooner or later this topic is going to become "popular." My concern is that it should first become popular with the defense establishment and the political community, and that we should start to invest time and resources in doing something about it. Already the World Wide Web is a substantial source for information (or misinformation) on terrorism.

We must be prepared for the "how-to" articles in *Soldier of Fortune* or even the magazines at the supermarket checkout counters. The Office of Technology Assessment already has provided the curious with a reasonably complete handbook on weapons of mass destruction, with a technical chapter on biological weapons [1].

### **Economics, War, and Technology**

Economics has been called the dismal science. Military economics may be regarded as the doubly dismal science. It probably is regarded by some as bad taste to investigate the cost of killing and I do not propose to do so in any great detail here. Not only are the data hard to come by, but the clear conceptualization of costs is difficult to formulate well and the

relative price level comparisons over the ages are notoriously tricky to construct. Given the level of peasant incomes through the ages, it is my guess is that it probably was rather expensive to kill someone in military action in early history. The deaths per Punt, Shokal, or Drachma probably were depressingly expensive during the growth of civilization. Fortunately for the military planners during early history, communications, transportation, and medicine were sufficiently bad that famine, disease, and death from wounds made the cost-effectiveness figures look somewhat better. But, this is an extremely microeconomics point of view. A more macroeconomics accounting would note that, if virtually all of the peasant population of an occupied territory dies of famine, there may not be enough able-bodied individuals left to plant next year's crops. Indirectly, killing a needed labor force does not add to the cost-effectiveness of one's army. Early in history, the great Chinese general, father of the study of strategy, Sun Tzu, remarked on the dangers of overimpoverishing the peasantry in war.

Yet another problem in calculating the cost of killing comes about in evaluating the costs of being killed and by whom. There do not appear to be any decent publicly available figures of "killed by friendly fire" casualties, but a little consideration of night actions, bombing, and artillery errors, bad visibility, hard to interpret signals, and other aspects of the fog of battle suggest that anywhere from 10% to 20% of one's own forces may not be too bad an estimate for twentieth century war. There is no information on fratricide for Roman, Greek, or other early times that I have been able to locate. The valuation of the loss of one's own human capital stock by self-inflicted killing also should be taken into account when calculating killing costs.

My guess is that the historical peak in killing cost-effectiveness may have been achieved by Genghis Kahn and his immediate successors. Their technology did not seem to be much more than good logistics and communications, disciplined cavalry, and the reflex bow. Their decisions to massacre or spare the inhabitants of a captured city appear to have depended considerably on military economic considerations of how expensive it was going to be to capture versus accept a surrender, and what the administrative cost and threat to logistics a potential revolt would entail. In the writings on Genghis Khan, there appears to be some evidence that the Mongols tended to spare the lives of the better artisans.

The estimated deaths from the Mongol invasion of China appear to be staggering, but preponderately due to famine and plague rather than straightforward military killing. I doubt the accuracy of both the figures for overall world population and the count of Mongol inflicted casualties, but a guesstimate of between 8% and 12% of world population probably is not too far from the mark, counting slaughter, disease, and famine. In modern terms, on a percentage basis, this is as though the United States and the former Soviet Union had succeeded in wiping out each other in a nuclear war.

### **Cost-and-Demand Elasticities of Weapons Systems, Externalities, and the Game**

Any good defense economist can point out one of the paradoxes of new weaponry. Not only may the cost of a weapons system far outstrip the initial estimates; every new system for offense generates a new system for defense, and thus the supply generates a new direct demand.

The strategic aspects of the economics of weapons development call for a continuous flow of improvement and innovation. Costs and supplies are in a constant state of flux. Many externalities are generated in the course of production, and these externalities easily may be of considerable negative or positive worth to society as a whole. A specific example is provided by the more or less unforeseen costs of disposal of nuclear waste. On the positive side, much of the revolution in air transportation and in communications after World War II can be attributed to the military developments during that war.

One of the perceived values of the atomic bomb was going to be “more bang for the buck” and the societal spin-off was going to be “virtually free electrical energy.” The early cost estimates did not match the current realities.

Innovation is critical to weapons development. But, the economics of innovation dictates that new product development and testing tend to be expensive. Once this stage has been passed, costs depend heavily on innovation in the methods of production and on being able to use mass production techniques. While this has been shown to be highly relevant in the development of nuclear weapons, aircraft, tanks, artillery, and communications systems, the direction in biological warfare appears to be different. The basic lethal components are cheap and can be manufactured in small batches with relative ease.

### **The Communication Revolution and the Weakening of the Nation-State**

The telegram and telephone are not much more than a century old. Radio is younger, television is a little older than a half century, the high-speed digital computer is slightly younger, and the personal computer and mass market cellular phone are younger still.

In the 1950s, much of the thinking about the role of the computer was biased toward its role as a great centralizing and controlling device. In the early 1960s, time-sharing firms envisioned great central computer installations much like central powerhouses. The invention of the personal computer completely changed the nature of usage. Today, the power of a personal computer, combined with new printing devices, the fax machine, and computer networks, has been an enormous force for decentralization. Any small organized group can economically print and distribute its message. Small common interest groups can be in touch by e-mail, the world over. The monopoly, or even partial monopoly, of a central government or large corporation over the means of communication had been shattered. National boundaries pose, at best, weak barriers to communication. At considerable expense, with vigilance, it still is possible to patrol national borders to prevent citizens from leaving or to catch illegal immigrants. A certain amount of control can be exercised over the flow of goods, but illegal immigration and the drug trade both attest to the growing permeability of world borders.

Even 30 or 40 years ago a well-organized dictatorship could suppress the physical means for information dissemination. This is becoming less and less feasible. The availability of new communications devices defeats the capabilities of even a dedicated police state.

Unfortunately, as it is with most changes, a shift which apparently cures one problem can easily create another. In particular, the speed with which misinformation, distortions, biased selections from the whole picture, and pure lies can be disseminated

greatly exacerbates the instability of mob behavior and creates the potential for mistaken premature action based on the passions of the moments as magnified by the mass media.

Tied in with the growth of communications networks in general, science and finance in particular, has come the opportunity for attacks on mass communications systems by small groups or individuals. The recent publication by T. Shimomura, with J. Markoff [2] illustrated the amount of damage that can be done by a single malicious “hacker” and the vulnerability of communications systems to sophisticated sabotage.

### **The End of Deterrence: Identification, Friend or Foe (IFF) and the Cable News Network (CNN)**

The period from 1945 until the breakup of the Soviet Union, more or less, was a time of a bipolar world. The war game contained the Red and the Blue. SIOP was aimed against RISOP (the United States and Soviet Union strategic nuclear plans). Damage exchange models could be worked out in fair detail with plenty of technical input and, depending on the level of aggregation and classification, even an amateur war gamer could paper his game room or study with a map of the United States and the Soviet Union with anywhere between a few dozen to many hundreds of targets with different priorities.

The heritage of Herman Kahn, Tom Schelling, Albert Wohlstetter, and several others built up a rich literature of ploy and counterploy; threat and counterthreat. A verbal, dynamic, two-person, nonzero sum, game theory debate flourished between individuals concerned with the plausibility of the threats employed and the defenses offered. Jesuitical (or Talmudic) fine points appeared in deciding when an act touted as defensive really was defensive or should be interpreted as offensive. But, all the way through this golden age of deterrence in a bipolar world, there were several implicit assumptions which are fast becoming obsolete.

The disparity in size among the five atomic powers (and the one or two more suspected atomic powers) was so great that, for many purposes, a good approximation of the “game” was between two coalitions.

Leaving aside the relative sizes of the powers, all of the analysis was based on the nation-state as the irreducible unit of action. The Irish Republican Army (IRA), the Red Brigades, the Hezbollah, Hamas were regarded as irrelevant to the conversation. The “crazies” could be an annoyance. They could place a car bomb here or blow up an embassy there. But, the casualties generated were to be measured at most in the tens and, by some stretch of the imagination, if the World Trade Center had not been so badly botched, maybe a few hundred or a thousand or two. Our conventional thought reserves the delivery of quick “megadeaths” as the domain of the major nation-state. But, with the change in technology, a well-organized, reasonably well-financed group of even less than a few dozen may be able to acquire a lethality larger than an atomic bomb.

In one of the Gilbert and Sullivan light operas, it is observed that “things are seldom what they seem.” In the world of CNN, a good riot staged so that it takes place at prime time might even be worth financing.

The coverage of the Persian Gulf War from Baghdad was not too far from having an American Jewish reporter interview Adolph Hitler at Treblinka. It is getting harder and harder to know who the actors are and what they are doing in a world of instant feedback. This is especially true where the entertainment value of war has increased and, instead of

Madame La Farge having to go to a crowded square to see the guillotine, where at most only a few hundred could have ringside seats, we now have the opportunity to create mood swings in millions at the same time. If country A has unfriendly relations with country B—and there is a small country C, or a small group within that country, which hates them both—if mass destruction were cheap enough, a major incident could be created by the third party in country A covered on prime time giving broad visibility to false clues provided by the perpetrators attributing the act to the perfidy of country B. The combination of virtually on-line communications with little improvement in IFF adds a new dimension to the world ahead.

A key element in much of old deterrence theory was that the nation and its potential foes were reasonably well informed about each other and that the IFF problem was kept to a minimum. Even then, there still would be some “Launch on Warning” problems to be considered to avoid the inadvertent start of World War III. But, on the whole, everyone had a program, knew who the actors were, and had a reasonably good view of their behavioral patterns. It is much more difficult to deter when you do not know who you are deterring. In spite of the Serbs, Croats, and Bosnians or the Hutu and the Tutsi, large groups of individuals, at least up to a point, appear to have some desire for survival. When one reads history in general and the history of religion in particular, it is not too difficult to locate small groups, both here and abroad, as their lethality increases.

The shift away from a bipolar world, together with the permeability of borders and the lethality of small groups, means that the burden of defense has increased. This increase has occurred because the old defense commitments have not gone away; they merely have been modified and new commitments have been added. We must be better prepared to fight many different types of war, ranging from global nuclear, conventional small wars, police actions, and now highly lethal terrorist activities which can arise from the actions of solitary psychotics, fringe ideological groups, criminal, or third-party sponsored agents.

### **The Biologist's War**

It has been suggested by Alan Beyerchen that World War I was the chemist's war. The fixation of nitrogen, the improvement in the nature and manufacturing of explosives, and the manufacturing of poison gas changed the technology of war. World War II was the physicist's (and engineer's) war with the advent of the atomic bomb, radar, and rocket systems. The cold war saw the proliferation of computation and communications. Integrated defense networks of a size and complexity unheard of a few years earlier became a viable possibility. The future, however, Beyerchen has suggested, may belong to the biologist. World War III easily could be the biologist's war.

Although it never made front-page news until recently, when the United States and Russia indicated that they wished to cease the stockpiling of materials for chemical or biological warfare, a substantial subindustry existed both in the United States and elsewhere from the 1950s onward, until Nixon terminated the program in 1971 [3]. It fortunately is difficult to obtain trustworthy open literature estimates on expenditures on chemical and biological warfare. Even if we had them, a considerable conceptual cleanup would be needed to make sure that the categories meaningfully reflected the purpose. A

crude guesstimate is that the United States may have spent somewhere between \$50 billion and \$150 billion on such a program.

An interesting exercise for those concerned with the accuracy of information would be to study the Central Intelligence Agency (CIA) and other U.S. estimates of Soviet military expenditures and compare them with the information that we now have obtained from Russia [4]. The observations above on numbers can be translated operationally as “a moderately large amount of money was spent” on chemical and biological warfare prior to the formal discontinuation of the program.

With the breakup of the Soviet Union (or the Russian empire, as some may view it) a certain amount of information concerning their work in biological warfare has come through to the West. The new horsemen of the Apocalypse in scholarly, scientific, and military garb, both in Russia and the United States, have smallpox, anthrax, plague, botulism, and many more items on the list to add to crop dusting, air conditioning systems, water supplies, food, and other means of mass distribution.

Unlike the development of nuclear technology and modern physics, all the economic indicators point to the goal of “killing on the cheap” actually being realized.

### **The Revolution in Biotechnology: Innovation and Costs**

Possibly the most exciting part of modern science at this time is biology. In the past 50 years, there has been an explosion in knowledge which at least equals and possibly dwarfs the computer revolution. Furthermore, the pace probably is increasing. The pace of development, by almost any growth measure, appears to be anywhere from 20% to 40% per annum. The production of new chemical compounds and biological agents is being revolutionized. New substances—some of which may be lethal, others beneficial—can be created at a rate undreamed of previously. As noted by M. Dando, “What would require the skills of a Nobel Prize winner in one decade will become common laboratory practice in the next. All or almost all countries have the ability to produce deadly biotoxins cheaply” [5].

From the economist’s point of view, what is happening in biological technology is not unlike what has happened in computer technology. In the beginning, there were IBM, UNIVAC, and a few others. The forecasters (including myself) were dead wrong. The industry did not remain one where entry would be virtually impossible due to the need for enormous capital investment. The trend toward centralization and the public utility image was reversed. Not only was the quasi-monopoly of IBM destroyed, so was the quasi-monopoly of AT&T. Today, whether it is computations or communications or in hardware or software (a distinction which is becoming more and more fuzzy), a few individuals with relatively modest financing have a sporting chance to go into business for themselves. The odds are that biotechnology is heading in the same direction. Not only do the costs of producing deadly substances appear to be plunging, but the size of the minimum viable manufacturing unit is small and the capital investment is being reduced. Furthermore, unlike the old-fashioned nuclear devices and their delivery systems, the means of delivery (although still an important and dangerous bottleneck) do not appear to be particularly expensive or require large centralized capital investment [6].



In the language of the old-time economist, the long-run costs appear to be falling and the industry probably will become more competitive with the barriers to entry low and the possibilities for small producers in specialized niches reasonably good.

### The Lethality of a Small Group

It has been suggested that history is a description of what happened by the winners or the descendants of the winners. Most winners tend not to boast about the massacres and disasters that they caused. If required to explain some unfortunate incident, humans have an ability to rationalize that far exceeds any ability in rational thought. Thus, a successful religion concentrates on shrines and festivals for its martyrs. Somehow, if a hundred or a thousand savages or unbelievers were slaughtered for every martyr celebrated, these individuals would be forgotten or their deaths regarded as incidental to a just cause.

Killing and the techniques for killing are not pleasant topics. Contemplating the cost and convenience of killing through the ages might even be regarded as bad taste by some. But, unfortunately, it is necessary.

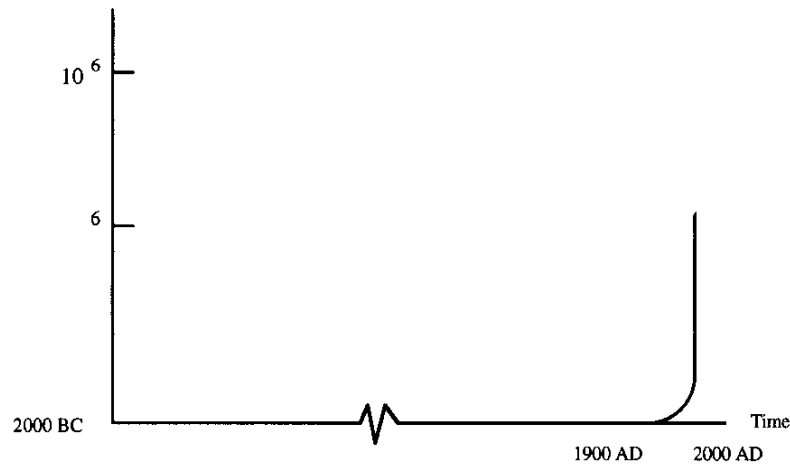
In the attempt to blow up the World Trade Center, an extra bar or two of spent plutonium would have made south Manhattan uninhabitable for a considerable time. Given the level of security at nuclear generating plants, the possibility for successful theft exists, but safe transportation certainly would cause an unskilled group some problems.

The history of development of the technology of warfare is a fascinating topic in and of itself. A brief and highly incomplete weapons list over time includes club, knife, sword, spear, shield, trident, trireme, reflex bow, cavalry, saddle, stirrup, crossbow, longbow, gunpowder, barque, siege gun, rifle, revolver, telegraph, telephone, railway, dreadnought, long-range artillery, machine gun, poison gas, submachine gun, plane, bomb, tank, helicopter, bazooka, submarine, computer, atomic bomb, modern artillery [7], rocket delivery system, and now biological warfare.

The advent of each item in its time involved not merely technology, but financing, the economics of manufacturing, and shifts in logistics and organization. The shifts, as units such as the battleship grew larger, called for more centralized organization and formalized routine for running many hundreds of individuals, who were strangers, in the same ship. Better logistics enabled army size to grow and called for the creation of a general staff to aid the commanding general. But, not all innovations call for bigger size and more organization. An increase in lethality or mobility of a small unit, be it a ship, tank, or commando group, can send the size requirements down, not up.

Figure 1 is a somewhat fanciful diagram of the potential lethality of a small group over the ages. The social sciences are notorious for drawing graphs and diagrams with ill-defined measures on the axes and showing items which are poorly quantified. I suggest that it may be worth attempting to sketch such a diagram, provided that the conceptual difficulties in measurement are explained and the diagram is interpreted merely as a device to sweeten the intuition or promote debate.

The horizontal axis indicates historical time. The vertical axis requires much specification and the leeway for alternative constructions is great [8]. In essence, the question to be answered is, What casualties can be inflicted by a small organized group of, say, 10 to 20 trained, dedicated individuals in a single action? The word "casualty" is vague. Do we mean killed during the action; dead from wounds several days, months, or years later (as



**Figure 1.** The lethality of a small group.

with radiation); or dead from starvation or disease indirectly caused by the action? How do we classify events, such as the burning of Rome or London, which could have been random or could have been arson? This sort of killing requires a probability measure. The conventional casualty counts, even for nuclear warfare, require lower and upper bounds and some form of expected value. In spite of the elaborate computations, complete with maps and diagrams around ground zero, the numbers presented can vary by an order of magnitude with a wind change or heavy rain at an appropriate time.

Raids by small groups of brigands or outlaws do not appear to last for more than a few hours. Strikes by terrorists tend to be even shorter. Although the load-reload time of the long-bow might be regarded as the harbinger of the trend toward automatic or multiple-shot long-distance weapons, it is difficult to conceive of a longbowman killing more than an average of one per 5 minutes for a 3- or 4-hour day. Close quarters weaponry, such as the sword, would have an even lower yield.

Mass executions, such as the crucifixions after the Spartacus rebellion, or the guillotine in the French terror, or mass murders in the German death camps, appear to be somewhat labor intensive and to require considerable organization. Hence, even if only a few actual direct killers are involved, they require at least the legal and usually the logistic support of the society or an occupying power. Terrorist or other dissident groups do not have this luxury. They may have financing, and some logistics, and communications provided by an outside power. But, in general, they do not have immediate local social and legal acceptance [9].

I suggest that, from 5000 B.C. to possibly as late as 1950 A.D., a comfortable upper bound on the lethality of a dissident group in any action was of the order of 1,000 [10], where the count was limited to killed directly or died from wounds. Since 1950, the change in the technology of killing devices and in logistics and communications, has been exponential. I have not yet been able to find clear examples of a dissident or terrorist strike exceeding a thousand fatal casualties (although the Aum Shinrikyo incident in March 1995 was a near miss with 10 dead and several thousand injured), but without

having to overdo the James Bond scenarios, the technology, logistics, and communications have been in place for at least the past 20 years and, since then and into the immediate future, the lethality is increasing to the point that by year 2000 the ability of such a group to wipe out a major city of 5 million to 10 million is highly probable.

A statistic that possibly is even more relevant, and even harder to come by, is the lethality of a single individual or a group of two or three. One of the pleasant paradoxes of human affairs is that secrets are best kept by one individual. A group of two can be reasonably silent. Possibly, three can keep an extremely low profile. But, above three, the chances for leaks due to boasting, sloppiness, interception of messages, or other causes increase considerably. Unfortunately, the lethality of the pathological behavior of the lone gunman has increased considerably by the availability of automatic weapons. The probability of detecting some individual in a group of size above one, as the group grows, soon becomes substantial in comparison to the probability of detecting a single pathological individual before it is too late.

### **The Dog that Did Not Bark**

I return to my opening Panglossian theme. Why are matters as good as they are? Why was the World Trade Center job botched so badly and carried out with so little imagination? Why did the Aum Shinrikyo fail to bring off mass murder?

Has there been a vast underground growth, during which the system gathers energy underground, not unlike a mushroom prior to emerging aboveground?

A sign of underground activity is provided by reports of the discovery of accidents. Every now and then a Weatherman managed to blow up itself with a badly built bomb. The safety of nuclear plants was brought into question by the disaster at Chernobyl. The anthrax accident at Sverdlovsk (April 1979) was a harbinger of the brave new world. But, the information originally was distorted, and the magnitude and implication of the casualties came out in drips and drabs. Possibly, somewhere in the Pentagon or in the archives of the CIA are estimates of the number of accidents which already have taken place in the United States at Richmond or Los Alamos, or in Iraq or France or elsewhere, involving contagion and death while testing a nuclear device or a man-made disease transmission device.

In August 1994, several individuals were arrested at the Munich Airport, purportedly as couriers for the transportation of weapons grade plutonium. It was conjectured that Russian scientists probably were selling it to customers such as the Libyans and Iranians in order to replace the salaries that they no longer were receiving. The sale of Siberian experimental nuclear reactors to the Chinese was another way of supplementing income. Are we just crying "wolf," or are we victims of too much science fiction? I suspect that the danger is real.

Is it that we are confronted with deep biological, sociological, or psychological inhibitors? What are the inhibitions? If they exist, do we expect them to last? I suspect that they exist at all levels and we appear to know little about them. However, even with little knowledge, it is a safe bet that, as the weaponry becomes cheaper and requires fewer individuals for delivery, a threshold will be reached where there will be enough socially alienated, mad, or fanatical individuals to break taboos or overcome the inhibitions.

### **Precedent and Inhibitions**

Our legal system pays much attention to precedent. There are actions which “civilized societies” do not take. Thus, to many of us, the death chambers of Nazi Germany or the rape of Nanking verge on the incomprehensible. Yet, when we go down the checklist on the use of chemical, biological, and nuclear warfare, this century, there are precedents for all three. The gas attacks in World War I, the atomic bombing of Japan, and the activities of Japan’s Unit 731 [11] provided the evidence. The poisoning of wells offers earlier historical precedent. It is evident that the unthinkable already has been thought and has served as a basis for action. W. Laqueur suggested that there have been amateurish attempts in the United States and abroad utilizing botulism, ricin (twice), sarin (twice), bubonic plague bacteria, typhoid bacteria, hydrogen cyanide, and VX nerve gas [12].

### **A Note on Capital Stock**

The world has made great strides toward economic liberalization. There clearly has been a decrease in Communist dictatorships and a growth of more or less free enterprise democracies. The threat of nuclear warfare carried with it twin levels of destruction. It wipes out both human beings and capital stock. The switch to biological warfare (to use a little ecotalk) is that it can be used primarily to destroy “human capital” leaving the physical capital stock intact [13]. Thus, the survivors in a world with reduced population could be potentially richer, not poorer, on a per capita basis than the nuclear war survivors, if they can prevent the capital stock from deteriorating.

This last remark is made partly facetiously, but there is a deep anthropological problem which cannot be dismissed merely because it appears to be in bad taste. Is there a sociobiological aspect to war? Could this be the way that our species, with its limited intelligence, keeps an upper bound on its population? Prior to World War II, the anthropology of war received some attention.

### **Malefactors against the Status Quo**

In some instances “it is hard to tell the good guys from the bad guys without a program.” Legitimacy is often a subject for debate, and the debate may be violent. When viewed through the eyes of previous occupants of positions of power or viewed many years after the fact, the use of force by Oliver Cromwell, George Washington, Simón Bolívar, Napoléon Bonaparte, Sun Yat-sen, Vladimir Lenin, Joseph Stalin, Adolph Hitler, Fidel Castro, Saddam Hussein, or Hafiz Assad raises some uncomfortable questions. When is a liberation movement dangerous and wicked, and when is it part of the progress toward a democratic society? The Irgun, the Muslim Brotherhood, Hamas, the IRA, the Tamil Tigers, and the fighters for the Basque homeland or a Puerto Rico independence group all have some basis for legitimacy in someone’s eyes.

Beyond the nationalists are those with social and religious causes. Thus, we have the Baader Meinhoff, the Branch Davidians, the Aum Shinrikyo, the Hezbollah, and various apocalyptic movements and freedom militia.

There possibly are five groupings worth considering separately:

1. national liberators;
2. social and religious causes;
3. criminal groups;
4. "rational" malcontents and disaffected; and
5. the nonsocial, psychotic, and otherwise alienated socially pathological.

One might expect biological attack blackmail from groups 3 or 4, but can expect usage from the three other groups.

### The Economic Future for Chemical and Biological Warfare

There still appear to be technical problems in the military use, and clean delivery and control, of chemical and biological weapons; in my estimation the more immediate danger lies elsewhere. All but one of the technical problems calling for innovation have legitimate, peaceful, productive reasons for solution. They are better transportation, packaging, and materials handling of deadly substances. The one purely hostile problem is weapons delivery, and it is in the self-interest of a small country to solve the delivery problem. It is likely that all of these will be solved in a relatively inexpensive manner. When they are, the potential for cheap, clandestine manufacture and delivery of chemical and biological weapons will show the characteristics of the American economic dream. It will become a growth industry, with ease of entry; more and more room for small individual entrepreneurs with capital requirements no more complex than a mini-brewery; many "promising" alternative products, a high level of innovation, and falling costs in procurement, manufacture, and delivery.

Table 1 provides some quick current technological and economic comparisons of nuclear, biological, and chemical weaponry.

**Table 1.** Economics and technology

	Nuclear	Biological	Chemical
Procurement	Hard	Relatively easy	Relatively easy
Manufacture	Hard	Relatively easy	Relatively easy
Storage	Difficult	Difficult	Difficult
Delivery	Hard	Hard and hazardous	Hard and hazardous
Group size	Fair-sided group	Few	Few
Lethality	High	High	High
Target control	Fair	Poor	Poor
Property damage	High	Low	Low
Cost effectiveness	So-so to good	Very good	Very good
Detection	High	Low	Low

## **A Program for the Future**

In a world where the stable door is usually closed after the horse has escaped, how do we disseminate what is known and what can we do about these new possibilities without creating panic and possibly encouraging deviant behavior? It is almost conventional wisdom that the military prepare for the last war. It also is a reasonably accurate view of public political behavior that, after a substantial "peace scare" such as the breakup of the Soviet Union, there is considerable pressure to cut defense spending. In spite of the end of the cold war, now is the time, unfortunately, to increase defense research on the unseen war. There is no easy solution available, but there are a few obvious steps to be taken.

1. Possibly the highest priority item is the least technical and least obvious. The responsibilities of the armed forces, police forces, Federal Bureau of Investigation (FBI), CIA, and the security agencies must be redefined in order to prevent "turf wars," bureaucratic foulups, jurisdictional fights, and bureaucratic confusion in major emergencies. The clarification of responsibility and coordination of action in the event of high lethality terrorist activity is vital. Casualties in the thousands are not matters merely for the police and FBI. It not only is a matter of recarving up jurisdictions, but a way for decisive coordinated action must be available. The jurisdictional problems are considerable, even in trying to capture a solitary computer hacker-saboteur as illustrated in the pursuit of Kevin Mitnick [14]. The distinctions among conventional war, nonconventional war, and terrorism are being blurred by the changes in magnitudes. The missions of the conventional armed forces, police forces, and surveillance agencies must be reconsidered.

2. The legal aspects of search and detainment must be reconsidered in view of the trade-off between individual rights and the magnitude of casualties feasible without prompt action. The compiling of potential terrorist lists and the surveillance of suspected individuals and organizations pose many sticky problems concerning civil liberty and the public right to know. Will we need a major disaster in order to revamp our procedures?

3. The dual-purpose aspects of the biotechnology production facilities and the ease of production pose considerable difficulties in the construction of a monitoring system that is not unduly bureaucratic and cumbersome. The problem of surveillance is well known and already has been addressed. It must be designed with the full understanding that a tight policing, such as is possible for nuclear fuel, is not feasible.

The three items noted above require attention and action now. There also are several open questions which require basic scholarly research.

4. A multidisciplinary program is required for the study of the psychiatric and socio-psychological profiles of terrorists and the alienated. There probably is an important distinction to be made between the pathological loner, criminals, and those with "a cause." An international comparison would be highly desirable.

5. We need to understand the positive and negative aspects of public education to major terrorist threat. Does the providing of information produce an "imitation effect"? Will showing individuals how to wipe out a town on the cheap produce an imitation effect as soon as one incident has taken place? How hard is the evidence that publicity concerning one event of bottle tampering triggers more events of bottle tampering? There may be no clean answers that hold for all populations. This is much like the question facing an air force general. Should he or she inform his or her pilots of the statistics on

their probability of being killed on a bombing mission? The answer probably depends on the personality of the pilot.

6. A somewhat scholarly, and not immediately applicable, question concerns man in particular and primates in general. Are there inhibiting forces which mitigate against a species self-destructing? Has the gap between technology and average intelligence and social organization reached a crisis level which makes self-destruction a serious possibility?

7. What are the symptoms of the new danger and how do we design systems to cope with them? What are the new false signals going to look like? There is good evidence that a considerable percentage of the airline bomb scares was calls put in by individuals who would miss their plane unless they could delay it for an hour or two. How large and reactive must a bioterrorism counterforce be? How badly overloaded will the system be with false alarms?

8. The legal system must keep up with the problems generated by the increasing manufacture of new toxic substances. This includes laws concerning registration, sale, transport, and possession. Can this system be designed to avoid Big Brother and deadly bureaucracy?

9. The doctrine of deterrence in a multipolar, clearly nationalist world still has a role. But, it is no longer enough. The simplistic "we and they" division to describe potential combat also is no longer enough. There not merely is an enemy, but potentially many small enemies from within, some of which may have other national or transnational sponsors. The IFF problems often have been solved on the battlefield by applying the maxim "shoot first, ask questions later." This does not seem to be a totally satisfying solution to what lies ahead. The concept of threat must be revisited. But, the subtleties to be faced go far beyond the disturbing, yet relatively simple, nuclear war world of Herman Kahn.

10. A new offensive weapon brings with it the research on defense and the counterweapons. Massive inoculations against some of the biowar diseases may be technologically feasible, but the economics quickly limits what can be done. The economics of defense does not look promising, but considerable study is needed.

## Appendix 1: A Cautionary Primer

The poet Samuel Hoffenstein, in his verse "Cradle Song" wrote:

Fear not the atom in fission:  
The cradle will outwit the hearse;  
Man on this earth has a mission—  
To survive and go on getting worse [15]

We should hope that his optimism is justified. A look at the activities at Sverdlovsk, Porton Down, Camp Detrick, Pine Bluff, or Ping Fan is not comforting. In 1972, approximately 120 nations signed the Biological and Toxic Weapons Convention. This was a step in the right direction but, unfortunately, adherence by nation-states is not enough.

Not only is the technology becoming cheap, the chances are growing for dual-purpose machinery suited, for example, for both a minibrewery and for less pleasant purposes.

The idea of biological warfare, at least in implicit form, is not new. It is probable that both the Greeks and Romans used infected corpses to poison wells. It has been suggested that Lord Amhurst presented the Indians with smallpox infected Blankets. In more modern times, at Ping Fan, Unit 731 of the Japanese army may have been responsible for several thousand "experimental science" deaths. The Iraqi-Iranian war saw chemical use on the Kurds. The actual deaths to date are minor in comparison with Hiroshima, Nagasaki, or the Dresden, Hamburg, and Tokyo firestorms. But, bean counting or corpse counting are not the appropriate measures. Our concern is with the shape of things to come.

## Notes

1. Office of Technology Assessment, *Technologies Underlying Weapons of Mass Destruction* (Washington, D.C.: U.S. Government Printing Office, 1993).

2. T. Shimomura, with J. Markoff, *Takedown*. (New York: Hyperion, 1996).

3. For a discussion of the diplomatic problems in obtaining a biowarfare treaty, see N. A. Sims, *The Diplomacy of Biological Disarmament, Vicissitudes of a Treaty in Force, 1975-1985* (New York: St. Martin's, 1988).

4. One feature that provides a deep challenge in the social sciences, in general, and in military studies, in particular, is the relationship between what the numbers appear to be and what they mean. For example, the current news that the Chinese are heavily reducing the number of individuals in their army could be interpreted as a splendid "dovish" sign. It also might mean that they are slimming down an outdated and more or less internally oriented and defensive military force and replacing it with a modern force with aggressive capabilities. In the terminology of economics, the capital labor ratio is changing along with the technology.

5. M. Dando, *Biological Warfare in the 21st Century: Biotechnology and the Proliferation of Biological Weapons* (New York: Macmillan, 1994) p. 210. I am grateful to E. J. O'Shaughnessy for pointing out this reference to me.

6. It should be noted that miniaturization appears to be taking place in nuclear weapons. The nuclear device in the attaché case does not appear to be feasible yet, but the trend appears to be heading in that direction.

7. The bureaucratic failure of Canada and the United States to utilize the genius of Gerald Bull is, in my opinion, nothing short of a tragedy. There is every indication that he may have been a highly unpleasant egomaniac. But, history and psychology to date show that there appears to be little correlation between genius and personality. In the chess game of international politics, the Israelis had little choice but to assassinate him when they did. Satellite launching via supercannon may or may not have been a technological possibility. But, this provides one more example where a historical turn set a cost pattern and developed a technology which might easily have gone in a highly different direction.

8. A linear rather than the log presentation is chosen on purpose to emphasize the change from "few" (0-300) to "many" (100,000 or more).

9. One should not forget that often it is hard to distinguish a terrorist from a patriot. Thus, in wars of liberation such as the American Revolution, the terrorist groups had the



support of at least part of the society, but did not have the support of the laws and government forces of the colonial power.

10. A list of major incidents since World War II shows no incident with over 300 dead.

11. P. Williams, and D. Wallace, *Unit 731: Japan's Secret Biological Warfare in World War II* (New York: Free Press, 1989).

12. W. Laqueur, "Postmodern Terrorism," *Foreign Affairs*, vol. 75 (1996): 24-36.

13. As long as you can get into the contaminated area, clean up, and bury the dead early enough, that the damage from lack of maintenance is not too bad. However, as the British found with their anthrax experiments, an area may be left infected for many years. One could attack crops and livestock.

14. See Shimomura, with Markoff, *Takedown*.

15. Samuel Hoffenstein, *Pencil in the Air* (New York: 1947.)