Choice and Constraint

by Robert J. Chassell

This document discusses the choices and constraints that shape us.

Edition 1.54, 20 November 2011

Table of Contents

In the Beginning . . .

How should we think about the choices and constraints that shape us?

> *Choice is an attribute we infer in others and apply metaphorically to systems that cannot choose. Constraint is an attribute that applies to any system, regardless whether it has choice.*

In the next few chapters, I talk about constraints and then the choices.

Constraints tell us 'what is'. Choices are what we 'can do'.

This is not the 'what is' or 'can do' of most political scientists, but the constraints and choices available to us on this planet.

Without investigators determining what is and what can be done, we are left in a world of irreality. Consequently, in a changing society, we need to support a fourth branch of oratory, a 'determinative' branch, and all that underlies it. (This fourth branch is only a few centuries old and is in addition to Aristotle's traditional three branches. He spoke of *judicial* oratory or "forensic" oratory; oriented to what the accused was said to have done, the past; *epideictic* oratory "ceremonial" or "demonstrative" oratory; oriented to the present; nowadays, this includes the kind of persuasion used in markets when price differences fail to signal significance; and, *deliberative* oratory or "legislative" oratory; oriented to what might be done, the future.)

Since most lack the time, the interest, the skill, or the funding needed to investigate, they must depend on the reports of others. For them to believe, those reports must come from trustworthy sources. Otherwise, people will suffer a hodge-podge of old ideas, dreams, and errors,

Of course, we also need institutions of government that do not depend on the virtue of those governed (although virtue helps). Fortunately, old institutions can be and should be continued in the present. (In at least one powerful country, the old institutions need rejigging to handle gerrymandering, although this action goes against the interests of many powers-that-be and is less likely than my other suggestions, which are helpful both to those currently with power and those without.)

Arguments Forthcoming

In more detail: in the chapter on *Political Necessities*, I point out that constraints include the need for security and law as well as the civilized constraints of justice and the importance of 'graceful winners' and 'graceful losers'.

In the following chapters, I note that governments need taxes and the planet needs regulation. Then, after discussing extralegality and other such issues, I back off and talk about the general characteristics of economics and the development of accounting from a very general point of view — as a form of governance. This leads into the problem induced by the intrinsic failure of any system that excludes 'external costs' from its internal accounting. For example, the cost of pollution is often institutionally 'external'. One

method of dealing with pollution, of internalizing the previously external cost, is simpler for a society and the other more efficient.

In every event, we live within systems that replicate themselves with error and error correction. This is what economies and societies are. It helps to understand their general characteristics, described briefly in the chapter on *Self-Replicating Systems*.

Next we consider how people understand the actions of their governments. Generally, they think of them in one of three different spirits: "can't do", "wrongly do", and "can do".

In a discussion of past mistakes, I mention several grim instances of "can't do" and "wrongly do". Jared Diamond suggests why they occurred. Then I give a contemporary example which many fear is or will be a disaster. In it, we can see all three possible responses: "can't do", "wrongly do", and "can do".

Following this, I turn to forms of persuasion. Aristotle spoke of three traditional branches of oratory. Unfortunately, his three branches presume that people understand the world. The consequences of an action may turn out badly, but they will be known. Unfortunately, in a changing world, that is not true. Nowadays, debates' consequences often depend on determining 'what is'.

So I talk about a fourth 'branch of oratory', the 'determinative' branch. This is science. Most people do not think of it as a 'branch of oratory', but from the point of view of societies, it is. Science is a way of persuading people that one aspect of what they see is more suggestive of reality than another.

How people perceive becomes important: so I discuss Guttman Scales, and the parallel four structures of social life. Then I talk about 'certainty factors', which is a specific mechanism to help make judgements.

Then I consider what should be done? What can we do? While I do offer various specific suggestions, more important are criteria and processes for everyone on this planet, everywhere.

The last chapter is called the *The Petals of Cooperation*. The petals are the four criteria for making judgements, *protect*, *preserve*, *prepare*, and *provide*.

In the flower's image I also discuss, as stem and leaves, the three conditions that enable a just and sustainable society to succeed, *consent*, *freedom*, and *law*. In the inner part, I suggest the five qualities you should seek to create through institutions in otherwise corrupt and dishonest politicians, *reason*, *rigor*, *reality*, *responsibility*, and *honesty*.

Further Efforts

After reading through quickly and briefly, you may wish to go further. My suggestion is that you determine how certain you judge each claim — perhaps some are weak — and you evaluate the proposals that are mentioned.

For judgement, provide evidence for (or against) each claim. The intent is to exercise 'determinative' oratory, as described in the chapter *Words Only*. However, the evidence will mostly, perhaps entirely, be 'I hear' or 'I know culturally', rather than 'I reason', 'I observe', or 'I experiment'.

Informally, the 'I hear' evidence will consist simply of cocking one's head and saying to one self, "right!" or "wrong!" or "somewhat suggestive". More formally the evidence will consist of scholarly references, news stories, or interviews. The 'I know culturally' evidence requires, I think, a convincing, personal story.

It is good practice to specify what you think is the certainty (or uncertainty) of each bit of evidence: whether it be a slight hint, weakly suggestive, suggestive, or highly suggestive, or the contraries.

Thus, there is text that says that Abraham Maslow spoke of a hierarchy of needs.

The not very important claim is that Maslow really did write. A more important claim about which judgement must be exercised is whether needs actually do form a hierarchy or ordered sequence? Perhaps they do not. Or perhaps the order is different. What is the evidence one way or the other? Perhaps Maslow provided enough evidence himself and an evaluation of each bit of it is not needed; or perhaps it is.

Then I claim that my sequence – order, law, justice, democracy – follows Maslow's:

> *The sequence of order and law provide for survival and security. Justice enables a person and family both to establish a meaningful society and for people and groups to feel properly esteemed. Democracy enables a society to offer solutions to needs.*

(Maslow's needs are survival, security, social, esteem, and self-actualization, even during periods of fairly rapid change. See `http://en.wikipedia.org/wiki/Maslow%27s_hierarchy_of_needs`.)

How suggestive is that claim of mine? How suggestive is the next one, Robert Rotberg's? (Robert Rotberg suggests a hierarchy in which his first two items are similar to mine. He then speaks about actions a government should do. They are to provide medical and health care, schools and educational instruction, critical infrastructure, a money and banking system, a business environment, a forum for civil society, and a method of regulating environmental commons.)

For evaluation, you can use the 'four Ps of politics' as listed in the final chapter – protect, preserve, prepare, and provide. You can use other criteria, too.

In each proposal, what is currently uncertain and what should be determined? If the underlying factors are sufficiently uncertain, should the proposal be revised to succeed regardless? If so, how?

For example in the chapter *What Should Be Done?*, I suggest that various contemporary nation states should join together to form a larger federation, a 'trans-national sovereignty'. I claim that the new state must be perceived by its citizens as legitimate. Is that true? What is the evidence for or against that claim? Will already existing bodies, such as the World Trade Organization, do as well in settling disputes peacefully? Will old fashioned diplomacy?

Will my proposal for a third legislative chamber be practical? Will rich countries be more likely to join if they feel safer than otherwise? Is the equivalent of 'states rights' or a 'veto' necessary, as I suggest? What should the rights be?

Political Necessities

What do you need to create a civilized society? Most basically, you expect a modicum of justice, not random violence or death. This constraint tells us what a government must do.

Order, Law, Justice, Democracy

In everyday life, the sequence of people's political desires is well defined. First of all, people desire **order**. Without order, life is chaotic and people die.

For a vivid picture of disorder, imagine gangsters or soldiers fighting, and a bystander killed. For a less horrific image, think of three mimes fighting another three with knives, and a bystander injured.

Next comes **law**, so people can predict those who may injure or kill them. Law is not necessarily just. The key is that law provide enough predictability for people to survive.

For an image, think of a prosecutor, two guards, someone they picked up, and a bystander who avoids them.

Dictatorships usually provide order and law.

After coming to believe they will survive, people seek **justice**.

As a mental animation, imagine a judge, two guards, and a judged person who goes free.

Because much of a sense of justice comes from what people learn as children, slowly changing, traditional societies often provide some degree of justice, even if they are not in any way democratic. Similarly, modern dictatorships sometimes offer justice in a few areas.

Justice is an accepted limitation on the arbitrary rights of a ruler. Injustice means that a ruler 'has the right to swing his fist' anywhere. Justice means that the ruler's right to swing his fist 'stops at the end of the subject's nose'. In traditional or dictatorial societies, the realm of justice may be limited, but many see that realm as better than nothing.

However, with changes in technology, traditional forms fail. For example, suppose you live by a river. In pre-industrial times, it is not likely you would be poisoned by the effluent of an upstream tannery that takes two or three hours rowing to reach. By the time the effluent reaches you the river would have diluted and transformed it. But a modern tannery produces much larger quantities of effluent, and it may contain more dangerous chemicals. Thus, under new conditions, new forms of governance become important. Otherwise through death, illness, or an unrecognized weakness, you pay for the cost of the tannery without gaining anything from it.

The disadvantage of traditional authority or dictatorship is that it may be inflexible. Perhaps a 'benevolent despot' is flexible. Certainly, everyone thinks of themselves as having the makings of a good ruler. And some will

be. But what of the second or third generation of rulers? What of the son of a 'good king'?

The inflexible need to leave. An advantage of **democracy** is that in it people can eject a government without civil war. A new government can change law and provide more justice.

Many governments fail to provide order and law. In that case, people group together to provide their own. Clans take on importance. So do villages in which the people who grew up together look suspiciously on outsiders.

These solutions help. But they do not scale. You cannot depend on clan connections when you deal with strangers. In a city, you will never experience childhood with everyone, only with a few.

One political response to increased scale is to increase hierarchic control (see "Guttman Scales and the Structures of Social Life", page 74). Traditional China is an example (see "High Initial and Low Incremental Cost Production", page 33): its mandarins and military ordered clans and villages. But China, once a technological leader, failed to adapt to the new technologies of the 18th and 19th centuries. Its government failed. After decades of civil war, a new government came into power in 1949. Over past years, the new government has shown remarkable flexibility. But the question still remains, supposing it continues, how well will it adapt to conditions two and three generations from now? Or will it freeze conditions?

In politics, a hierarchical control system can succeed so long as there is little or no change, or so long as the change is easily foreseen. The main problem comes during the succession. If one group does not gain full control, as in a monarchy or empire, competitors may fight. Such a civil war destroys both order and law. Often in history, a family or clan gained power in a civil war, succeeded for a period, and then its members became excessively corrupt or lazy. These failings enabled a new dynasty to gain sufficient support to enable it to win a civil war and replace the old dynasty.

However, even with dynastic change, hierarchical political systems fail to adapt well to change: their very success causes failure. They are similar to the companies that Christensen and Raynor describe in *The Innovator's Solution*[1]. A company's management, its ruling group, institutes methods for employees to follow. Middle managers, the equivalent of captains and colonels in an army and of middle level civil servants, learn enough of their company's culture to prevent anyone higher up from learning about many propositions. This filtering prevents those higher up from being overloaded. Consequently, many a successful company or government carries out only actions that fit what the organization has already been doing successfully.

[1] *The Innovator's Solution: Creating and Sustaining Successful Growth*, Clayton M. Christensen and Michael E. Raynor, 2003, Harvard Business School Press, ISBN 1578518520

Christensen and Raynor suggest ways for a company to avoid losing to a competitor that achieves success by following a process that another business rejects as too small or too inadequate. Essentially, the new way means setting up a new organization within the company that is separate from the old, with different cultural values, different rewards for success, and different goals.

As a political system, democracy does the same: it enables an opposition to become the government. The opposition may well have different cultural values, different rewards for success, and different goals from the previous government.

When you view an 'opposition' as a part of an overall political system, then its step into power is like the elevation of one division, previously small, into the lead of a corporation.

As Przeworski said (`http://bostonreview.mit.edu/BR21.2/Przeworski.html`), this means we need

> *. . . a clear party system with stable parties, a vigorous opposition . . .*

Without them, the overall political system fails.

Interestingly, the idea of a flexible political system arose before the notion of a flexible corporation. In the past, the overall economic system was presumed to include many corporations, some of which would die. Flexibility lay in the competitive, free market economic system as a whole, not in its components. The Christensen and Raynor solution enables a component, a corporation, to thrive.

Incidentally, Abraham Maslow spoke of a hierarchy of needs:

- survival,
- security,
- social,
- esteem, and then, once those are assured,
- 'self-actualization'.

The sequence of order and law provide for survival and security. Justice enables a person and family both to establish a meaningful society and for people and groups to feel properly esteemed. Democracy enables a society to offer survival, security, social, and esteem, even during periods of fairly rapid change.

This analysis is optimistic, for it suggests that democracy will survive unless a catastrophe ruins us or a powerful government stops or slows change. (See `http://www.teak.cc/softfree/software-freedom.html#Limits%20to%20Learning`.)

In more detail, Robert Rotberg suggests a hierarchy in which his first two items are similar to mine — my four are: order, law, justice, and democracy. Then Rotberg speaks about actions a government should do. Next he talks of what people need for them to decide on justice, "a forum for civil society", and finally he speaks of "a method of regulating environmental

commons" which in practice means a legislature composed of the various interests, deliberating.

Rotberg's paper was for the U. S. Central Intelligence Agency's National Intelligence Council's 2020 project, and called "Nation-State Failure: A Recurring Problem". (See `http://www.cia.gov/nic/PDF_GIF_2020_Support/2003_11_06_papers/panel2_nov6.pdf`.)

- Security

  As Rotberg says, "This the state's primary function. It provides a framework through which all other political goods can be delivered."

- Law

  Rotberg refers to law as "A system of codes and procedures which regulate the interactions of the population and sets the standards for conduct."

- Medical and Health care
- Schools and Educational Instruction
- Critical infrastructure
- A money and banking system
- A business environment
- A forum for civil society
- A method of regulating environmental commons

Liberty and Resources

Some years ago an ecologist named Paul Colinvaux[2] advanced the political hypothesis, that,

> *Liberty* is almost always associated with groups of
> people who have more resources than they might expect.
> With more than expected resources, people feel they have
> the freedom to focus on 'the higher things in life'
> since they do not feel as constrained as their parents.
> The 'higher things' encompass religion, political idealism,
> antinomianism in general, and libertinism.

This is based an ecological metaphor for human actions. A consequence is that elites feel both liberty and constraint sooner than others.

In an agricultural, preindustrial society the poor stay poor. But increased resources, be they from trade or conquering one's neighbors, translate to more slaves or servants for the rich. There are more opportunities for a man (and even occasionally a woman) to concern himself with non-tactical

[2] *The Fates of Nations*,
Paul Colinvaux,
1980, Simon and Schuster
ISBN 0-671-25204-6 hardback

things. Moreover, it becomes feasible for the society to create a few more high status, resource consuming jobs, such as that of assistant chief priest, assistant bishop, or assistant chamberlain.

These people do not care to give liberty to others — certainly not to their slaves or tenant farmers; but they are interested in their own freedoms.

However, in the usual course of history, a group more than reduplicates itself. There comes a subsequent generation in which the number of elite children more than match the resources. Each child has fewer material resources. (Incidentally, this is why second and subsequently born boys were forbidden to inherit a part of a landed estate in England.)

Similarly, a society can only create a few new high status positions; otherwise the positions become common, and lose their status. As the number of elite children increases, it gets harder and harder to gain a 'place'. So it makes sense to be more tactically oriented, more survivalist, less keen on freedoms for others like oneself, more keen on getting ahead.

We who live in the advanced industrial societies are in a similar kind of world, except there are vastly more material resources and considerably more status resources. You can gain a respectable position, like that of a vice president, in any of many companies, non-profit organizations, or government bureaucracies. (However, the number of very top positions remains the same — there is only one Prime Minister or President per country, only one president of the 'largest corporation').

So the Colinvaux model applies to us as well as to people in the past.

Eventually, of course, people get used to the level of resources they have. Consequently, this hypothesis is bad news for the long run of a sustainable society. But the process can take considerable time, perhaps two generations or more.

During the transition, people will consider themselves richer or poorer than they expected. And act accordingly.

Graceful Winners, Graceful Losers

For democracy to succeed, losers must be willing to lose — they must 'lose gracefully'. Equally important, winners must not push the losers into subversion — they must 'win gracefully'.

In his excellent book on *Democracy and the Market*, Adam Przeworski[3] points out that in transitions from tyranny to democracy, democracy succeeds only when the process is not undone. For success, the losers must not subvert the process, but go along with losing.

[3] *Democracy and the Market*,
Adam Przeworski,
1991, Cambridge University Press, Cambridge, UK, p. 29
ISBN 0-521-42335-X

Likewise, the winners must also act gracefully. Otherwise the winners will persuade the losers that they have nothing more to lose.

If the losers are bad guys, they will not avoid subversion from the goodness in their hearts. Bad guys will avoid subversion only because they calculate that going along is better for them in the long run. Perhaps they will win next time. Or, in any event, they hope to gain more benefits by being good losers than by fighting.

Periods of Unraveling

(Much of this section was inspired by *Generations*[4], a book by William Strauss and Neil Howe.)

In a 'period of awakening', like the 1960s in the U. S. or the 1640s in England, one of two things happen: either 'the revolution' loses, as it did in the U. S., or it wins.

A 'period of unraveling' follows the 'period of awakening'. New sets of solutions are proposed, but are never well implemented. Both when the revolution loses and when it wins, the outcomes lead to the adoption of solutions that fail: either the solutions are a repeat and increase of the old solutions with minor tweaks, which was mostly what happened in the U. S.; or the solutions are the implementation of new methods that turn out to fail in practice, as in England under the Commonwealth.

Another way to look at the 'awakening' of the 1960s is to see it as a failed social revolution: 'radical' suggestions were made for solving contemporary problems.

In the subsequent period of 'unraveling' the Awakeners' suggestions were mostly **not** followed; and when they were followed, the solutions are changed on implementation to ways that are very different than originally proposed.

For example, in the 1960s when people talked of cleaning up polluted sites, they did not expect the United States government to spend as many tax payer dollars on litigation as digging. Yet in places that happened. Similarly, the people who opposed incarcerating the mentally ill in state mental hospitals did not intend to move many of the former inmates to prison. And, when space enthusiasts talked of a 'shuttle' they were not expecting a design that costs **more** to take a kilogram into orbit than the previous, use-once Saturn launch vehicle.

Following the 'unraveling' is an ensuing 'period of crisis' during which the proponents of one set of solutions win; their solutions are implemented.

---

[4] *Generations*,
William Strauss and Neil Howe,
1991, William Morrow and Co.,
ISBN 0-688-08133-9

The losers are defeated. They lose their jobs and positions of authority, and the newspapers and other media are either scared into self-censorship or directly censored.

The period following is called a ‘high’ by Strauss and Howe, since everything moves along in a fairly predictable fashion, even though it is heavily criticized at the time. As soon as nostalgia has a chance to operate, the period looks good.

In the United States, for example, the 1950s are called a ‘high’, yet at the time, schooling was a problem, race was a problem, the economy was a problem, military preparedness was a problem, conformity was a problem, lack of interest by elite college students in major social issues was a problem . . . although better than the preceding depression and war, the period did not appear to be much of a high at the time.

Fortunately for the U. S., most ‘highs’ have been more or less benign.

But a ‘high’ does not have to be benign; it can simply be inadequate. In the mid-Victorian era, for example, it has been suggested that the United Kingdom went though a muted awakening that led to a muddling through of the subsequent unraveling and crisis — not a disastrous outcome, but not as successful in the long run as people in that one-time Empire might have wished.

One might argue that the U. S. post-Civil War high was also inadequate. The Federal government permitted whites to reimpose local racist rule in the south; it permitted major private corporations to establish near-governmental power over many areas; and when government got directly involved, it permitted private corporations to co-opt the government regulatory agencies.

It has been said that it took the 1930s to overcome the mistakes of the 1880s. Moreover, I need not remind you that the response to the 1930s took the United States from being the world’s biggest creditor before the 1980s to being its biggest debtor. (And you do not have to be a U. S. nationalist to regret the loss of autonomy caused by debt, merely a democrat, with a small ‘d’.)

Taxes and Regulation

What a government must do . . .

Tax, Borrow, Scrimp

What else can a government do other than tax, borrow, or scrimp? Governments need to spend money. Does a government have any other source of income than by borrowing or by some form of tax, whether it be an income tax, a value added tax, or an inflation?

If a government does not want to fund itself, what other choice does it have than to cut spending, to scrimp?

Yes, a government can sell property that it owns. But it cannot do so for long, except in unusual situations, such as the U. S. in the 19th century. And that 'unusual situation' did not last.

I do not see any other options.

As I write in 2004, the U. S. government is borrowing vast sums. Much of its borrowing is funded by the Japanese government, which is purchasing U. S. government bonds with Yen created at virtually no cost to the Japanese.

This is a good purchase for the Japanese government, since even if the U. S. dollar falls in value, the Japanese government, having paid almost nothing for its Yen, will continue to own a claim against the U. S. taxpayer.

However, there may come a time when enough Americans wish to disown others' claims. When that happens, the U. S. government will not be able to borrow. It will have to raise taxes.

As George Washington said in his Farewell Address as the first United States president,

> *. . . towards the payment of debts there must be revenue; that to have revenue there must be taxes; that no taxes can be devised which are not more or less inconvenient and unpleasant . . .*
> (See `http://www.yale.edu/lawweb/avalon/washing.htm`.)

The simplest way to raise taxes and at the same time to disown others' claims is to run an inflation. To use old-fashioned language, a government 'prints money'.

The United States arranged its governing institutions such that no one part of government can run an inflation alone. Instead, the Executive branch of the government must borrow dollars from the Federal Reserve. In turn, the Federal Reserve must be willing to lend those dollars. It will only lend if the Legislative branch is willing to pay interest on the borrowings. The interest can, of course, be paid by borrowings, at least for some years. If all three groups agree, then money can be created readily. As in Japan, the cost of creating money is low. In addition to the paper work, it involves adding zeros to a computer account. This is less expensive than in the old days,

when governments had to print on paper. But even then, 'printing money' was cheap.

It goes without saying that inflations, especially large inflations, tend to destroy an economy. I am leaving that aside.

When a government, such as the United States Bush Administration increases spending on the military, on drug payments for the elderly, on farm subsidies, and the like, it either must borrow more or raise taxes. There is no alternative.

The Bush Administration cut taxes, so it must borrow more. Indeed, both it and others predict the deficits will go on for years. The deficits do not have the look of Keynesian counter-cyclical deficits, since they persist regardless of the state of the economy.

(In the past, some argued that the Bush Administration wanted to reduce overall government spending. It was said that the Administration had to increase military spending, but would cut back on other types of spending. However, its increases in drug payments and farm subsidies have disproved that argument. It is not a 'tax and spend' administration, as people have complained about some Democratic administrations, but a 'borrow and spend' administration.)

While a trusted government can borrow for a long time — it can borrow so long as its anticipated increase in revenues is larger than its anticipated costs — there may come a time when anticipated costs rise dramatically, or when the government becomes less trusted. Either problem raises the risk premium for borrowing.

An increase in the risk premium raises the cost of borrowing. Such an increase often precipitates a disownment. The terms used to describe such an action vary. A newspaper may say that a central bank stopped maintaining a 'currency peg'; or it may say that a government declared a 'moratorium' on certain loan payments. Regardless of the language, the action is to disown a promise once made.

Needful Government Regulation

Under the right conditions, competitive, free markets succeed. (In this case the word 'succeed' means that competitive, free markets efficiently allocate economic resources; there is no claim that they provide security or justice or other non-economic benefit. Non-economic benefits are not an issue in this discussion.) For competitive, free markets to succeed, the situation is key.

Among others, three conditions must be met:

- that everyone have full knowledge;
- that economic activities never enjoy or suffer externalities, and;
- that high initial, low incremental cost production never occur (see "High Initial and Low Incremental Cost Production", page 33).

Of course, we know that these conditions fail: people do not know everything. Cars and other 'goods' release exhausts, which are external 'bads'. Moreover, steel and flour mills, oil refineries, railroads, radio broadcast systems, and automobile manufacturing are examples of century-old industries that have high initial and low incremental costs.

(It cost Henry Ford a great deal of money to build his Rouge River plant, but once built, it cost relative little to manufacture an additional 100 Ford cars each year, up to a maximum.)

Products that are dependent on information, such as medicines, and products that are pure information, such as songs and software, are examples of current goods with high initial and low incremental costs.

A government can permit a market to allocate goods when people know of risks, when private and social benefits are the same, and when no industries with decreasing costs exist.

But when investors seek corporations with limited liability, when they desire laws of bankruptcy, when negative externalities, like thrown-away paper, litter the landscape, when the steel, automobile, and software industries exist, then governments have a job.

There are reasons for governments to regulate economies. And, in theory, governments can do the job, or at least enough of the job to help a little.

However, in practice, governments often fail. The people in governments act to promote their interests, or the interests of their associates, rather than the interests of their country. Thus, in the latter 19th century in the U. S., railroad companies used the Interstate Commerce Commission to prevent competition among themselves that they felt was dangerous. In the 20th century, major U. S. food companies 'captured' the U. S. agency set up to regulate them. While the food they sold became safer, at the same time, they reduced market competition against themselves.

So the issue becomes one of governance: what institutions will enable you, a citizen in conjunction with other citizens, to make sure that your agents do as you wish?

This is a traditional 'agent/principal' question, except that it is applied between politicians and citizens to rather than between employees and their managements or between civil servants and politicians who are in office.

You and others citizens are the 'principals': you give the orders. In theory, your 'agent' acts on your behalf.

For example, you may not know why you are feeling ill; but an agent might: in this case, he would be a medical doctor. So you 'go to the doctor'. He knows more than you about medicine.

(Indeed, the medical market is enabled by a lack of information on your part and the existence of specialized information on the part of others. If you could treat yourself, you would not need to visit a doctor. Similarly, you do not know about your future health or accidents. Consequently, in the U. S., many people who can afford it purchase health insurance.)

If, in your opinion as a 'principal', your doctor, your 'agent', fails to do his job, you switch to another. If you like him, you continue to visit him. By your actions, you provide your agent with information telling him whether his actions are perceived as beneficial to you, the principal.

When you cannot switch — perhaps your doctor is the only doctor in town — or when you do not know enough to decide when to switch, your actions as a principal will fail.

Then your so-called agent will be free to do as he or she likes. He can shirk. She can maximize her income. He can enhance some other personal goal. For example (to talk about a problem a friend of mine, a nurse, just mentioned), she can help a large company convert a fatal condition to a chronic condition that can be maintained through continuing treatment rather than find a cure that implies a one-time treatment. While saving lives is good, the social cost (and private cost to you) of suffering a chronic condition is worse than the benefit, both public and private, of a cure. But the cost to you and to the public may, depending on institutional motivations, be profitable to some.

As the Nobel Prize winning economist, Douglass C. North wrote

> *. . . institutions basically alter the price individuals pay . . .* [1]

Moreover, it turns out that details matter: if citizens do not learn about the failings of their agents, they will not vote them out of office. This means that citizens, or their other agents such as journalists, must not only pay attention, they must not be cowed. Your other agents must tell you what is really going on. If they are cowed in any way, or if you are cowed, they or you will be poodles, not tigers (see `http://www.teak.cc/softfree/software-freedom.html#Poodle-Teams`).

There are more details. As Adam Przeworski says in *A Better Democracy, A Better Economy* (`http://bostonreview.mit.edu/BR21.2/Przeworski.html`),

> *What's needed . . . is a clear party system with stable parties, a vigorous opposition, an effective system of checks and balances, a decent level of information that focuses on general economic performance, and non-electoral mechanisms for control over specific policy realms or particular organs of the government.*

Without these features, neither a market nor a command economy will be efficient at allocating economic resources. And without some degree of economic efficiency, neither you nor anyone else will be able to afford security, justice, or beauty.

---

[1] *Institutions, Institutional Change, and Economic Performance*,
Douglass C. North,
1990, Cambridge University Press, pp. 6, 22
ISBN 0-521-39416-3 hardback
ISBN 0-521-39734-0 paperback

In the present world, for example, the current population is too large to be supported by the old technologies of the past. We could, if we chose, now feed everyone on the planet. But we could not even think of doing that if we were limited to the economic efficiency of a century ago.

Governance

A good civilization requires good governance.

Developing and Extralegal

When thinking of 'the' economy, the salient territory is the planet, not your country. Moreover, 'the' economy is developing, not developed. In addition, most of the people and money involved are outside the formal law.

Put another way, 'the' relevant economy is global, developing, and extralegal. It is an old habit among Americans and West Europeans, but misleading, to think of the entity as national, developed, and legal.

Legality is helpful. For example, when controlling pollution, consider the circumstances in which the pollution producers live: if the plant is located in a territory with a good legal system, then a government regulated market (see "Pollution Market", page 27) makes sense; but if the plant is located among the corrupt, banning makes sense. And if the plant is located among the highly corrupt, the only way for an outsider to protect health may be war.

For me, the first part of my insight about the world economy comes from Edward Hugh (`http://www.livingontheplanet.com/bl/archives/000566.html`), who described

> *. . . the economics meme of the decade: stop thinking about the global economy as a series of slightly inter-connected national economies, and think of it as one global developing economy with nation state based market imperfections.*

Hugh is right. In more detail, he said,

> *. . . instead of seeing the global economy as a collection of individual . . . economies with a limited degree of global opening . . . we should be seeing the economy as one entity, with a whole series of market imperfections where we find the nation states.*

(Hugh attributes this notion to Andy Xie of Morgan Stanley, who wrote of *a global economy* (`http://www.morganstanley.com/GEFdata/digests/20040415-thu.html`). Although Xie did not write of *a global developing economy*, at least not as far as I could find, Xie does write of the world economy as global. Since most of the world is developing, the implication is that the economy is both global and developing.)

The second part of the insight comes from Hernando de Soto, a Peruvian, who noted[1] that

[1] *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else*,
by Hernando de Soto,
2000, Basic Books, New York,
ISBN 0-465-01614-6,
(See `http://www.ild.org.pe/tmoc/cp1-en.htm`.)

. . . it is legality that is marginal; extralegality has become the norm.

Put together, these notions tell us that we should look at 'the economy' as global, developing, and extralegal. This means that the central bank of the United States, the Federal Reserve, is wrong to focus only on U. S. problems. It means that those who seek the rule of a single law for the whole will fail when they focus on the (relatively speaking, for businesses) reliable, quick, and honest legal systems of countries like the United States (see `http://www.teak.cc/softfree/software-freedom.html#Reliable%20Quick%20Honest%20Legal%20System`).

Instead, the Federal Reserve should consider how its actions have planetary influence: if you follow this reasoning, then there is a strong argument that recent economic volatility comes as a consequence of actions made for local reasons that have global effect.

For example, it is argued that in the early 1990s, the Federal Reserve kept United States' interest rates low to help American banks recover from governmental mismanagement of Savings and Loan institutions. Consequently, large funds traveled to China, where investors hoped for a higher rate of return. That money inspired a Chinese inflation, which the Chinese government eventually crushed. For several years, this wiped out prospects of high rates of return in China. Therefore, funds traveled back to the United States, where they were invested in stocks and property, helping fuel the asset price inflation or 'bubble' of the late 1990s.

Moreover, rather than expect businessmen to be able to borrow money from and settle disputes with strangers (the great benefit of a reliable, quick, and honest legal system), investors should remember that most entrepreneurs depend on family, clan, friends, or crooks. The businesses run by such entrepreneurs must remain small.

On the one hand, this limitation means that local businesses will lose when competing on an equal footing with existing, large 'Western' companies. They can never raise enough money to do otherwise. (Note the constraint that the competition be 'on an equal footing'. If the small local company pays no taxes and the large 'Western' company does, the small local company may survive, as did Russian retail operations in 2004.)

On the other hand, this limitation also means that the overall market, and the potential for investor's profits, will be smaller than hoped.

If you take this view seriously, the conclusion is two-fold: first, within developed countries such as the United States, people who work directly or indirectly for the nation, such as those on the Federal Reserve, should focus on the impact of their actions on the planet, as well as on the country. Since the global impacts may echo back upon them, this focus is in their own long term interest.

Second, investors should figure how to support de Soto and his programs for adapting formal law to existing social contracts rather than the reverse. This way, investors will be able to make higher returns in the long run.

In the short run, investors should note that without a reliable, quick, and honest legal system, only dictatorial empire provides a mechanism for settling disputes among strangers, as was done for so many millennia among the Chinese.

The problem with empire is that its decision makers have no incentive towards fairness. They are neither paid and permanent judges nor randomly chosen juries, but managers who will help themselves, their families, and their friends by finding and accepting the largest bribes possible. (They may not call their sources of extra income "bribes", but see them as rightfully earned high salaries or rightful in some other way.) Such a system favors the already rich, which is another way of saying it harms most businessmen, since most are not as rich as those at the top.

But the alternative to empire may be difficult. For example, what if people in business think that only members of their families are part of the group with whom they should be honest. Or people with whom they have, over time, developed a deep relationship, with whom they have a 'connection'. In this situation outsiders are not salient at all. It is not a question of disagreement or misunderstanding, but of disregard.

This issue has nothing to do with the way one should treat a parent or with criminal law; it is about business dispute resolution: how one business settles a dispute with another, the other being, perhaps, distant and its people strangers. In the United States this is the subject of 'tort law'.

Hernando de Soto is trying to persuade people that land titles enforced through a reliable, quick, and honest legal system are worth while. He started by asking why capitalism has succeeded in countries such as the United States but failed in most of the world?

As he says,

> *The cities of the Third World and the former communist countries are teeming with entrepreneurs. You cannot walk through a Middle Eastern market, hike up to a Latin American village, or climb into a taxicab in Moscow without someone trying to make a deal with you.*

But their talents do not translate into riches.

The reason capitalism succeeded in the West, de Soto argues, is that in past centuries, countries such as the United States adapted the formal law to existing, actual social contracts. In the U. S., for example, in the 19th century, white squatters were given legal title to land they settled, rather than evicted.

Just as it is possible to ban legal sharing of software, it is possible to make other activities so difficult, like building a house legally or starting a business legally, that people become 'extralegal'. (De Soto focuses on real estate and other rivalrous assets, not on readily sharable assets like software or speech.)

De Soto argues that an 'extralegal' life costs 10 % – 15 % of a person's annual income in bribes and such. It also prevents a businessman from improving his business beyond a certain small point. It stops him from competing with larger, 'Western' companies.

Without a reliable, quick, and honest legal system, a weak person or organization cannot settle a dispute with a stranger. The courts and police provide the strength. But people seek them only if they perceive them as friendly (or friendly 'enough'). In order for everyone to feel safe in approaching them, they must therefore be fair. Otherwise, they are perceived as a tool for one group.

Without a good legal system, you must depend on your family, clan, friends, or a criminal gang. For small groups, such help succeeds. But you cannot obtain capital from strangers this way.

Bankers who are strangers to you will not lend. They do not know you or know how to track you down if you do not pay. If you default, they cannot find your collateral for the loan. They fear that you will default and they will not be able to recover their money.

Successful banks in countries such as Bangladesh often make loans only to groups of women who all live in the same village. These are people who will not run away and who are unlikely to default for social reasons.

The problem, as de Soto says, is that

> *. . . property law and titles imposed without reference to existing social contracts continually fail: They lack legitimacy.*

Indeed,

> *. . . it is not your own mind that gives you certain exclusive rights over a specific asset, but other minds thinking about your rights in the same way you do.*

No World Government

I do not think a 'world government' is possible whether or not it would be desirable. But governments covering larger territories are possible now, but only if they provide several sources of power.

But first why is the notion of 'world government' now dead?

Two generations ago, 'good government' people ('goo-goos' they were called by their enemies), liberals of all kinds, and others, favored a 'world government'.

They saw that the United States formed out of previously independent states. In Europe they saw previous enemies coming together to form a common market. By a parallel reasoning, they figured that the United States, the Union of Soviet Socialist Republics, France, and Egypt could all join together in a powerful and unified federation.

My father, I remember, told me that the different countries that sent diplomats to the United Nations were no more different than the original

thirteen colonies that came together to form the United States. The U. S. had slave states in the south and free states in the north; it had politically powerful men who made their living on agriculture and it had men of commerce. His belief was that if the various parts of the U. S. could come together voluntarily, then in the modern world, everyone could come together.

Moreover, he believed this could happen peacefully.

Nowadays, people think differently. First, few think the U. S. or China, to take two examples, would both peacefully give up their sovereignty.

Secondly, I have not recently heard either modern U. S. Liberals or Democrats favor a world government. Certainly, none have said that they favor a world government under a politician such as George W. Bush.

Indeed, a good many Liberals and Democrats in the U. S. argue that the U. S. should not conduct wars abroad, and that the U. S. war in Iraq (in 2004) is a mistake.

If implemented, an anti-war policy would prevent the U. S. from taking part in military operations designed to make a 'Federated World Government' an effective trans-national sovereign rather than a pretend sovereign. It means that the U. S. could go no further than support a permanent diplomatic conference, a 'talking shop'.

At the moment, as far as I can see, the only people in the U. S. arguing for governmentally-funded coercive action on a world-wide scale are people on the political right. They are dismissive of non-U. S. influence, which is to say, they are against a new government that reduces U. S. power.

Consequently, both the Bush administration in the U. S. in 2004 and its domestic opposition are against a world government.

That tends to kill the notion.

But a different proposal pops up: not a world government, but a 'coalition of the willing' or a 'union of democratic states'. The idea here is to replicate the experiences of the U. S. and the EU in their founding. The goal is to bring together countries that want to join each other, and are willing to surrender some of their sovereignty in the process.

I do not think that people in the United States' Bush Administration envisage a new organization that would reduce U. S. sovereignty. They speak of acting unilaterally. But other U. S. Republicans might figure a new form of government would help them.

(Some of these people, like James Webb, President Reagan's Secretary of the Navy, have referred to the U. S. invasion of Iraq as *the greatest strategic blunder in modern memory* (see `http://www.usatoday.com/news/opinion/editorials/2004-02-18-veterans-edit_x.htm`). Others are fearful of the Bush Administration's deficits. Even when deficits profit them in the short term, they look at Federal government deficits that are projected to extend forever, and fear that the country will become weak in a genera-

tion or two. They may figure that they should embrace an organization that might help them in the long run.)

In “A Larger Federation”, page 94, we can see a solution that might reduce the chance of serious war.

Economics

Do large fortunes tend to grow? Are competitive, free markets unstable? I explore these questions through an analog: the beginnings of a science fiction story in which you explore an island full of tentacled entities whose ecological rules match those of our business society.

Then I discuss early accounting and how double entry bookkeeping served to increase control. But traditional accounting fails under certain circumstances. And if you enjoy a reliable, quick, and honest legal system, then a market for pollutants is better than a ban on them.

In any event, we live in a world in which more and more products come from economic processes with a high initial but low incremental cost. This has dramatic implications.

Tentacle City [a fable]

Far away, at a distant time . . .

You are exploring a strange planet.

A hundred tentacled entities live on an island. The other members of the expedition persist on calling these entities 'tents'. You came up with a much nicer name, but you have since forgotten it yourself. The 'tents' come in all different sizes, from small to very large.

As expedition ecologist, you have found that these 'tents' eat various resources around them, more during better conditions, less during poorer conditions. They also eat each other; indeed, some find others delicious. (This is endocannibalism, a fairly rare phenomenon on account of the risk of picking up pre-adapted diseases from the eaten entity.)

'Tents' can grow bigger or smaller. Like many bacteria or cancer cells, they are potentially immortal. They die by starvation or when they are eaten by another. Unlike humans, they do not have any 'natural' age of death.

Conditions on the island vary in a quasi-predictable way. There is little to eat during bad seasons and much to eat during good seasons. (You complain about the way language is used since a 'good season' is defined as one with lots of food, but no one else pays attention.)

Seasons come and go, with considerable but not utter regularity.

Seasons vary in their severity; some bad seasons are worse than others. Also, some parts of the island almost always provide lots of food, but other parts are barren even during the best seasons. In some respects, the landscape is not unlike Scotland.

You observe that larger 'tents' can survive longer without eating than smaller 'tents'. And some 'tents', regardless of their size, are better at finding food than others. But none can turn bare rock into a feast.

New ‘tents’ appear every so often. These ‘new births’ appear in various sizes although most are small. None appear as large as some of the old ‘tents’.

Now for the economics, which in this analog is modelled by ecology.

Will large ‘tents’ will always do better than small ‘tents’?

Let us presume that the ‘tents’ possess a minimum viable metabolic rate plus a metabolic rate based on mass.

For a business, a minimum metabolic rate makes sense. To survive, a business must produce a good or service, find customers, and sell to them. Even if the business does not sell any goods or services, perhaps because of a depression — the equivalent of our tentacled entities’ starving during a bad season — the business must support at least a few people to hold it together. Or else it will vanish.

In your studies, you find that a tentacled creature has a minimum viable mass and metabolic rate of one kilogram and loses a bit more than one-half kilogram per week if it does not eat anything. (Mostly, when starving, a tent hibernates. But it does wake up every so often to see whether conditions have grown better.)

Put another way, a tent needs one-half kilogram per week for every kilogram it masses at the beginning of that week. If it does not eat this one-half kilogram per week, it loses weight.

```
Met_Rate = 1 + 0.5 * Mass
```

Thus, at the end of one week, a starving tent that starts out at 100 kilograms consumes (1 + 0.5 * 100) = 51 kg: the one kilogram that is its minimum metabolic rate plus the one-half kilogram per week for every kilogram is masses initially. Consequently, when it does not eat anything during the week, it ends up weighing 49 kg.

Does Size Matter?

You find a colony of 50 ‘tents’ of 100 kg each and 50 of 10 kg each. They all follow the metabolism rate described above.

Bad times occur. This is what happens to the individuals in your colony:

	mass of each little ‘tent’	**mass of each big ‘tent’**
Week one:	10	100
Week two:	4	49
Week three:	1	23.5
Week four:	dead	10.75

At the beginning of week five, you find that all the ‘little tents’ have died, but that 50 ‘big tents’ are still alive.

You rediscover the old proverb, that when starving, those with more fat live longer.

New Births

Every so often new 'tents' are born.

Most start out small, with many one kilogram 'children' and a few ten kilogram children. There are no 100 kg children.

Food turns scarce in yet another season. All the youngsters who mass less than 10 kg die of starvation within a month.

Fortunately, the bad times are followed by good times. During the period of plenty, children grow larger.

Growth

A colleague notes that in times of plenty, after eating enough to grow at their basic metabolic rate, 'tents' eat enough to grow at a rate proportional to their mass.

The basic metabolic rate requires eating one kilogram plus eating one-half kilogram per week for every kilogram it masses at the beginning of that week.

```
Met_Rate = 1 + 0.5 * Mass
```

The faster growth rate is this rate plus eating enough such that a 'tent' can gain 10% of its mass per week by eating 20% of its mass per week.

The new equation is

```
Met_Rate = 1 + 0.5 * Mass + 0.2 * Mass
```

(which is simply `Met_Rate = 1 + 0.7 * Mass`).

In other words, it is harder to grow than to survive.

(Your colleague is beautiful and you might have fallen in love but for circumstances. Of course, I don't know your sex or your culture, so I don't know whether a romance could occur and if it did, any details.

(Indeed, I don't even know your species, although a xenobiologist might infer that your home sun is a K type star from learning that your multi-faceted 'bug' eyes are most sensitive at a nearly 800 nm wavelength rather than at the 560 nm or so wavelength characteristic of human color vision[1].)

But times of plenty are followed by times of scarcity. Are smaller 'tents' more adaptable than larger 'tents'? Are they more able to survive a relatively short period of scarcity? Or do big 'tents' enjoy so much extra fat that they can survive the downturns better?

Worse, what happens when a large 'tent' discovers that it can eat a small 'tent' and then also eat the smaller entity's former food?

At least you and your colleague can theorize together:

---

[1] *World-Building*,
Stephen L. Gillett,
1996, Science Fiction Writing Series of Writer's Digest Books,
ISBN 0-89879-707-1

Suppose a big 'tent' can easily eat a much smaller 'tent', but has a more difficult time catching and eating a similar sized 'tent'.

In this case, more or less similar sized 'tents' will persist. Few will eat each other. But smaller 'tents' will be eaten. The number of smaller 'tents' will depend (among other factors) on the birth rate and the time which it takes a larger 'tent' to digest a meal.

If by some chance or other — perhaps the 'tent' grew up in a fertile valley or it figured out how to eat more efficiently — one 'tent' becomes bigger than all the others, then it can devour everyone else. The other 'tents' will die. The only survivors will be those who have not yet been eaten, either because they are too far away or because the larger one has not gotten to them.

Either one big 'tent' survives, or a few. Small 'tents' come into being; but all get eaten eventually.

Economic and Political Implications

Our bug-eyed monsters' fictional expedition is actually an attempt to simulate what happens with corporations in a capitalistic society such as our own.

I hope that most of you agree that the 'ecological rules' I postulated are more or less accurate representations of the circumstances in which businesses find themselves.

- 'Tents' must eat some food every week, and more if they are bigger.
  Businesses have fixed and variable costs.
- Small 'tents' starve to death in a famine.
  Weak businesses go bankrupt in downturns.
- 'Tents' enjoy lots of food during times of plenty.
  Businesses are more likely to survive in good times than bad.
- Some 'tents' find that a nearby volcano erupted, and not only did not kill them, but fertilized the soil.
  Some businesses find themselves in a newly developing industry that offers many opportunities.
- Large 'tents' can eat smaller ones, but may take some time to digest their food.
  Bigger businesses can take over smaller businesses, but may take a while to make good use of their acquisitions.

(If you do not accept the accuracy of these rules, I would like to hear of 'rules' you think are realistic, expressed as descriptions of the circumstances in which these tentacled beings find themselves.)

Finally,

- You find that your colleague is partially wrong in thinking that all sized 'tents' grow at the same rate if they feed enough.
  Often, small businesses grow faster than big ones, but some big businesses figure out how to grow fast even though they are big.

This latter issue is perhaps the most controversial question in politics and economics: I have heard some people argue that big companies can never be as efficient as small companies, because big companies are insufficiently agile. But others say that big companies have more resources, and so can do more.

As far as I can see, optimal size depends on circumstance.

For example, Christensen and Raynor[2] claim that large companies (see "Order Law Justice Democracy", page 5) do better with what they call 'sustainable' technological development, because they can afford the resources. But they also say that small companies do better with 'disruptive' innovations.

Big companies lack senior managers who have an interest in the initial markets of a 'disruptive' innovation because those markets must be small. Worse, a big company that is successful has created a company culture that filters out ideas that might lead to small markets because the company needs big markets. Success can only come to a big company that creates a new part of itself to avoid the processes and values that benefit the big company elsewhere.

This action is like a large 'tent' budding a new, small 'tent' that goes off to discover whether it can find any food growing on a recently weathered lava flow.

The political implication of this exercise is that wise anti-trust actions against both monopoly and oligopoly are required (see "Needful Government Regulation", page 13) even when there are few or no 'barriers to entry'. A large business or a group of large businesses may keep on growing (see "High Initial and Low Incremental Cost Production", page 33).

I speak of 'wise' action because there are times when sustainable innovation requires the large resources available to a single or to several large companies. But there are other times when one or a few large companies should be broken up into smaller entities so their managers adopt different goals and different processes.

Many say 'the market will take care of it', but that is not true in all situations.

A Market for Pollutants

The Nobel Price winning economist, Douglass C. North, made the point that

> *In a world of uncertainty, no one knows the correct answer to the problems we confront and no one therefore can, in effect, maximize*

[2] *The Innovator's Solution: Creating and Sustaining Successful Growth*, Clayton M. Christensen and Michael E. Raynor, 2003, Harvard Business School Press, ISBN 1578518520

> *profits. The society that permits the maximum generation of trials will be most likely to solve problems through time . . .*[3]

This notion points out how to organize society more effectively.

To a friend, I once wrote,

> On the other hand, a market is more efficient than a ban, but more complex to administer. . . .

To which my friend asked,

> *Is the first part "a market is more efficient than a ban" a statement of faith? I would hope so, since it is hardly provable.*

I responded in turn by saying,

> It is not a statement of faith, but I did leave out the arguments for it.

Consider the problem posed by people who try to poison me and others by releasing pollutants into the air when they generate electricity.

If our government decides that this sort of activity should be reduced, it has two choices:

- '`Ban polluting emissions.`'

  This means telling a company that its emissions at its smokestack must be less than some value, or else the company will pay a fine. (People often think that a ban means 'zero output' of what is banned, but that is not what is means in practice, which is to reduce an output below a certain level.)

  A ban also means organizing a policing unit to check smokestack outputs and/or providing outsiders with a legally permitted mechanism to check companies' actions and take them to court if they violate the ban.

- '`Organize a market`' to cause the various companies involved in electricity production to internalize the cost of pollution; and to penalize them for producing pollution.

  This means deciding on the total amount of the pollutant that will be permitted into the environment and setting up the legal environment that enables people and companies to write contracts regarding the release of this pollutant.

Banning is simpler than creating a market. It is simpler administratively and simpler in terms of how people think and perceive (see "Scales and Structures", page 74). A ban is categorical. It is the simplest of the Guttman scales. A market requires thinking in terms of a ratio scale, which is the most complex scale.

---

[3] *Institutions, Institutional Change, and Economic Performance*,
Douglass C. North,
1990, Cambridge University Press
ISBN 0-521-39416-3 hardback
ISBN 0-521-39734-0 paperback

A market is difficult to create: to succeed, a country needs an administrative system that is not excessively captured by the companies the administration is supposed to regulate (see "Needful Government Regulation", page 13). In addition, it needs a reliable, quick, and honest legal system (see `http://www.teak.cc/softfree/software-freedom.html#Reliable%20Quick%20Honest%20Legal%20System`). Otherwise, the process will become a source for bribes and not do the country any good.

Suppose an electric power company owns four power plants, all burning coal:

- Two of the power plants are old and can produce 500 MW each of electricity and release 100 tonnes of ash for every N kwh produced.
- One power plant is moderately new and can produce 1000 MW of electricity and releases 50 tonnes of ash for every N kwh produced.
- One power plant is new and can produce 1000 MW of electricity and releases 20 tonnes of ash for every N kwh produced.

The average demand for electricity from these plants is 2250 MW; the peak is 2700 MW.

Consider two ways of paying for the reduction in pollution. Please bear in mind that the consumer, namely you, me, and others, will end up paying. I have an interest in a lower electricity bill! The poorer you are, the greater the interest.

The alternatives are:

- **Ban** pollution; for example, have a government agency state that the permitted pollution level for each plant be under 40 tonnes/N kwh.

  This means that three plants need to be retrofitted: the two old plants and the middle-aged one.

- Create a pollution **market** by having a government agency state a total amount of permitted pollution that (as it happens) leads to exactly the same number of tonnes of pollutant entering the air per year as in the ban.

  This means that the electricity producer pays some cost when operating the middle-aged plant without having retrofitted it and a considerable cost when operating the old plants without having retrofitted them.

The question is, what is the cost to electricity buyers, to gain the same low level of pollution production?

The **banning technique** means that three plants will have to be retrofitted.

The **market technique** means, most likely, that the middle-aged plant and one of the old plants will be retrofitted. The new plant produces a low level of pollution and will sell its 'pollution credits' to the other old plant. And that old plant will be turned off when power demand is below peak. The electricity customer pays less to reach the same level of pollutant output.

Generally speaking, the second method, the market technique, costs less for a given level of pollution, presuming a good government.

The reason is that different plants are built with different technologies and have different ab-initio pollution outputs and different costs of retrofitting. (As a rule of thumb, for the same reduction in pollution, older plants pollute more and cost more to retrofit than newer plants, per unit of electricity produced. New plants, for example, use different kinds of burner than old plants and build ash collectors into their exhaust systems.)

The same argument applies to 'intrinsically polluting' operations, such as burning fossil hydro-carbon for fuel. If two plants are equally efficient, then the one burning natural gas will release less carbon dioxide than the one burning coal, per unit of electricity output. So the idea is to tax fossil carbon, to encourage a switch to fuels that use less or no fossil carbon. (I have heard it suggested that in the U. S., an effective 'carbon tax' would increase the cost of auto gasoline by 10 or 15 cents per gallon. I have no idea if these numbers are good suggestions, but such numbers are what the controversy is about.)

If the contrast is between two 1000 MW plants, one burning coal and the other using uranium, the latter will possibly release a catastrophic amount of radiation, but the former will continually release low levels of radiation in excess of what the nuclear plant releases.

(There is uranium dust in the ash that comes out of the smokestacks of coal-fired power plants. I have been told that coal-fired power plants in the United States have been exempted from the radiation release regulations that nuclear power plants must follow; otherwise, coal-fired power plants would be shut down on account of their low level radiation releases. An acquaintance, a public health specialist, once told me she researched just how much radiation is released and could not get good figures. I do not know if the problem has been exaggerated by nuclear power plant operators or downplayed by those who own both nuclear and coal-fired plants. As far as I know, natural gas plants do not release radiation; they do not have much if any radon in the gas, and no dust.)

The alternative to a fossil carbon tax is to ban fuels that contain fossil carbon, or ban types of fuel. Thus coal might be banned, but natural gas permitted.

However, such a ban immediately wastes the sunk investment into coal burning plants and means that natural gas pipelines must be built to areas which have readily available coal. The idea behind a differential tax is that it discourages new investment in the more expensive fuel and encourages more investment in and full use of plants that use the less expensive fuel.

Since I want both less pollution and lower electricity bills, I prefer the more efficient method.

This is why I favor fossil carbon taxes and other such mechanisms that cause companies to internalize the costs of what economists call 'external goods' and to penalize the companies for producing outputs that hurt me and others.

It goes without saying that as courts and government agencies become more corrupt, the market method becomes less efficient and the banning method better. If a government and its courts becomes even more corrupt, then nothing can be done, no method is efficient, and we are doomed.

Accounting in the Middle Ages

I am not an accountant, but some years ago I read a history of early accounting[4]. What struck me was that the metaphor that led to double entry book keeping was *balance*, and that from an outsider's point of view, it was hard to find profit.

All in all, for double entry book keeping, three new ways of thinking must emerge, one of which is balance. A second is that humans can create entities separate from themselves; they must be able to create golems, as it were. A third is that humans must think of time as linear.

In the Middle Ages, an enterprise started when a few people took a chance to support it. Perhaps, also a usurer would loan it money. The difference between the investors and the usurer is that the usurer was supposed to be paid regardless of the success of the venture, but only a fixed amount. The investors might lose — pirates or a government might seize a cargo, or a storm destroy it — or they might gain hugely.

The venture was seen as an entity separate from those who put money into it. This was a key notion. In particular, the owners were not the entity. Another key notion was balance; that idea was possible because no one yet thought in negative numbers.

A venture possesses assets, such as the ship to carry the goods, the gold to buy the silk, or the silk itself (or, more prosaically, the silver to purchase the grain). The people who put money into it are either the investors or the usurers. Investors own equity; the usurers are a liability.

Thus, the basic accounting equation:

> *the assets of an enterprise have the same value as*
> *the money put in by usurers and investors.*

Or, in modern and, for most people, more boring language;

```
assets = liabilities + equity
```

An increase in liabilities means a bigger loan from a usurer who trusts that he will be paid back. The usurer is a creditor, a word that comes from the Latin, 'trusts'.

An increase in equity means a bigger investment from an owner.

---

[4] If I remember rightly, the history ended before 1494. That is the year when Luca Pacioli, the 'Father of Accounting', published his famous work. Or perhaps I did not read more. I cannot remember the title or author of the history, only that it was published a long time ago. (See `http://acct.tamu.edu/smith/ethics/pacioli.htm`.)

Before the invention of negative numbers, the value of the enterprise was seen as a positive number. Consequently, an increase in what the business owned, an increase in its liabilities or equity, was seen as an increase in assets.

And indeed, the more put into the business, the more are its assets. People could understand that the value of an enterprise equaled what it owes. The amount owed was a definite debt. The amount received was also definite. Indeed, if everyone were honest, the two had to equal.

The metaphor is like that of an old fashioned balance scale: on the right hand side is put the weight of the liabilities and equity, all definite. On the left hand side is put the weight of assets; also definite. Unless someone steals, the two must balance.

Moreover, balance continues on a smaller scale. During a venture, it looks as if the overall total of assets for an enterprise does not change. The composition changes, but if there is no theft, balance remains.

Suppose you exchange gold for silk. The amount of cargo increases. The venture gains a load of silk. The amount you must pay the seller also increases (from nothing to the value of the shipment). The values of both balance.

In modern thought, we would say that as a result of your payment, the value of cash decreases, which is a negative number. At the same time, the value of your cargo increases by a positive amount. And the absolute value of the negative number is equal to the absolute value of the positive number. This way of thinking also works, but it is more abstract than the notion of a definite debt balancing a definite gain.

Suppose your voyage is a success. You come home and sell your silk. Now the amount of gold you have increases; but its value equals the value of the silk you must give your buyers. Another balance.

Dissolve the venture: everyone receives his money, including the usurer. What is left over goes to the equity investors. The exact value of the enterprise is divided up among those who are owed money from it. Nothing is stolen. Again a balance.

Everything balances. A careless Medieval thinker, more used to brigands and predatory barons who steal, may well wonder how profit comes from balance? To understand how profit and loss occur, you must think over time. This is a third key notion. Not only must you think of what you pay for the silk here and now, but you must learn what the merchant paid months ago, and what it cost to ship it.

Put another way, rather than think of time as circular, or a spiral, a round of seasons, months, and religious celebrations, you must think of time as linear.

You must think of the Christmas last year as being very different from the Christmas of this year, even though both are similar religious celebrations

of the birth of your savior. (And which is more important for you, being saved for ever and ever, or a little silk?)

Double Entry Book Keeping

In the beginning, double entry book keeping had two purposes:

- to provide information, a description of an activity;
- to provide an agent-principal mechanism whereby a principal gains more control over an agent (but not much).

As an informational tool, double entry book keeping depended on the ability to compare apples and oranges (see "Guttman Scales and the Structures of Social Life", page 74)

Put another way, a Medieval trader exchanged gold coins for silk. The gold and silk were compared in one way, by their monetary value, but not in others. (It is famously impossible to keep warm with gold, but you can make warm socks with silk.)

Double entry book keeping records only the 'internal costs' of a business. It does not record 'external costs', such as pollution. Such costs are invisible to a business. The only way to make them visible is for a government to force external costs inwards successfully (see "Needful Government Regulation", page 13).

When governments are weak, or when pollution is so limited it can be ignored, businesses do not pay for external costs. In effect, they receive a subsidy from the people who suffer.

As an agent-principal mechanism, accounting enabled a principal to check whether his agent was doing as previously agreed. In the Middle Ages, the principal was usually an older man or group of men who put up the money for a venture. The agent was usually a relative or a young man hoping to marry a daughter or niece. Because of the familial connection, or because of hope, no one expected the agent to act too corruptly; the goal was to keep his corruption or his stupidity in line.

High Initial, Low Incremental Cost Production

Contemporary drug development and production is an example of an activity with a high initial cost and a low incremental cost.

Law enforcement and war are the same. Interestingly, many years ago, they became government actions.

Think of ancient China. It covered an area the size of Europe. The most powerful state beat the others and established a unified government. The initial cost of creating an army was high; but after that, the cost of conquering one more city was low (for the government with the powerful army). In Europe, however, mountain ranges and the like made it too expensive to conquer the whole continent, until modern technology was developed. The Romans, Charlemagne, and Napoleon each conquered only a part.

Over the past century, in 'private' industry, steel, flour milling, oil refining, railroads, radio broadcasting, and automobile building had the same economics. A century ago, it cost a great deal of money to build a steel works. But once built, it could produce steel at a low incremental cost (up to a maximum). The same with railroads. It cost a great deal to build a railroad from New York to Chicago; but after it was built, the additional cost of running 100 extra trains per year was very little, relatively speaking (up to a maximum that was seldom achieved).

That is why, in the 1880s, American railroad companies asked for and the U. S. government created the 'Interstate Commerce Commission' to regulate railroads. Previous requests, by less powerful groups, had not brought on U. S. government regulation. The ICC prevented price wars that would overtly hurt railroads. As a secondary effect, the ICC also reduced railroad companies' price gouging of others. This very popular political side effect is why many still think of government regulation as an anti-capitalist action. Instead, it is an anti-competitive market action that prevents an oligopoly market from becoming a monopoly — that prevents an economy with a few separate organizations from being overwhelmed by one.

In the U. S., steel, flour milling, and auto manufacturing industries developed into oligopolies. They used oligopolistic pricing techniques to keep prices high enough for them. (I was taught these price setting techniques in university. The methods are legal. Amazingly, during the 'electricity crisis' in California a few years ago some laws actually were broken. There was no need. The 1995 ban on long term contracts — cleverly called 'deregulation' — meant that high prices and high profits could be made legally. Only the most greedy would bother to break the law; yet that happened!)

In Europe before the EU, markets were smaller. So monopolies were created instead of oligopolies. The monopoly format was different in different countries: in the UK, 'associations' (or whatever the legal phrase was) became important; in Germany, banks. (Chandler describes this in his book *Scale and Scope: The Dynamics of Industrial Capitalism*[5].) In Russia under Lenin, the state took over. No one called the result 'capitalism', except for those who referred to it as 'state capitalism'.

In the Soviet Union, the 'leading industrial sectors' included steel, coal, railroads, and electricity. Since education, law, and government were not considered industries, they could not be leading. They had to remain backward: and people stayed ignorant, courts remained unjust, the government corrupt.

In the contemporary world, drug development is expensive; but the cost of manufacturing incremental doses is low.

---

[5] *Scale and Scope: The Dynamics of Industrial Capitalism*,
Alfred D Chandler Jr,
1990, Harvard University Press,
ISBN 0-674-78944-6

On the one hand, you can fund drug development by maintaining a government enforced high price for incremental doses. This high price pays for, among many things, development costs.

In the United States, the doses are paid for directly, or very often, by insurance companies or by the taxes (direct or indirect) that pay for non-insured people to go to emergency rooms. And, it goes without saying, some people do not purchase these drugs; instead, they suffer and die. This is the current method in the U. S..

On the second hand, you can impose an 'official committee' to decide what to do. This method was used in the Soviet Union. It failed.

On the third hand (this is a science fiction reference to a story about relations with aliens who suffer a lack of environmental resources; also, it is a reference to the Christian Trinity; and, of course, it is a reference to the Trinity nuclear bomb test. Nuclear weapons are an example of a high initial cost/low incremental cost weapon), you can fund drug development by having a government tax people and then pay the proceeds to large numbers of independent organizations — to universities, for example. (In such circumstances, pharmaceutical companies would generate revenue by making and selling drugs, as 'generic' drug manufacturers now do.)

When funding large numbers of independent organizations, a government needs many different funding agencies. Instead of one or five or ten 'official committees', it needs more. With too few 'official committees', the process fails.

With lots of different 'official committees', many different experiments are funded. Some may provide useful drugs.

I quoted Douglass C. North earlier. He said that in *. . . a world of uncertainty, no one knows the correct answer to the problems we confront . . . .* This is a key notion. This is why it is useful to encourage research, even if you are a stick-in-the-mud.

Moreover, if you do not encourage learning, a necessary basis for research, and if you do not accommodate eccentricity, you will not gain as much as you might from research. As a consequence, you may suffer from a foreigner.

Governmental funding is not always needed. In the U. S., Europe, Japan, and in some other parts of the world, we are rich enough that some people can produce a certain kind of high initial cost product at relatively low costs to other funders. Aristotle talked about this form of production.

In Aristotle's day, the rich produced plays and government; they depended on slaves. That is why Aristotle said slavery was a good idea until 'the shuttle could weave by itself' — which modern technology enables.

More precisely, according to Benjamin Jowett's 1885 translation of *Aristotle's Politics* (`http://www.mdx.ac.uk/www/study/xari.htm#1253b23`), Aristotle said:

> *. . . if every instrument could accomplish its own work, obeying or anticipating the will of others, like the statues of Daedalus, or the tripods of Hephaestus, which, says the poet,*
>
> *of their own accord entered the assembly of the Gods;*
>
> *if, in like manner, the shuttle would weave and the plectrum touch the lyre without a hand to guide them, chief workmen would not want servants, nor masters slaves.*

Software is a high initial cost product. Unlike steel factories or drug developments, it can be created by people who are relatively rich — the practice is called 'commons-based peer-production'[6] — without requiring that others fund the extremely high costs of a steel works or a potential drug's clinical tests.

Software enjoys low incremental costs. Around the world, a CD manufactured with information on it, transported and marketed, sells for the local currency equivalent of U. S.$1.50 - U. S.$2.50 in a free and competitive market. A higher price tells us that the country's law enforcement is effective at maintaining a higher price.

'Generic drugs' are less expensive than 'patented' drugs. They do not have government-enforced high prices and their incremental production cost is low. Many different manufacturing organizations produce them. Generic drugs are not sold in a monopoly or oligopoly capitalism market, but in a competitive, free capitalism market.

(Incidentally, I talked of manufacturing additional units of software that is sold on CDs. Note how cheap it is to manufacture additional units of software on a machine you own — to manufacture additional units when you, to use Marx's phrase, 'own the means of production'. Indeed, the cost is so low that we do not use the word 'manufacturing'. We use the word copying. But reduplicating — copying — is what happens in manufacturing.)

There has been a huge change in technology over the past 200 years. In the past, law and war were the best examples of high initial and low incremental cost activities. Now many important activities are like them.

Over the next generation, one struggle will be over the kind of pricing that is used for the products of these technologies.

[6] *Software Freedom: An Introduction*
(see `http://www.teak.cc/softfree/software-freedom.html#Software%20Dangers`)

The Nature of Self-Replicating Systems

Countries, economies, and societies all continue over time; they replicate themselves, more or less. In this sense, they are like species and ecologies.

Since it is hard to think dispassionately about one's own society or species, it behooves us to use an analog that illuminates relevant constraints and choices. Von Neumann Machines serve that purpose.

A von Neumann Machine is a self-replicating device.

> [*I always think of a von Neumann Machine as a self-replicating device. Von Neumann himself called such a machine a "Universal Constructor". Some people use the phrase to refer to computing machines that use a single storage structure to hold both the set of instructions on how to perform the computation and the data required or generated by the computation. I call this the von Neumann architecture.*
> (See `http://en.wikipedia.org/wiki/Von_Neumann_machine` and
> `http://en.wikipedia.org/wiki/Von_Neumann_architecture`.)
>]

For any kind of von Neumann machine, a basic question is how big a portion of itself can it reproduce? Can it reproduce itself entirely, or only partly? The reproduced fraction is the system's 'closure'. A closed system reproduces all it parts. An open system fails to fabricate some of itself. For an open system to continue, some parts must be imported from outside. A farm or factory need not be fully self-reliant but can be partly open. On the other hand, a complete natural ecology can only be closed.

Incomplete closure makes sense when efficiency becomes a concern. Can you afford to do all? Even if possible, the cost of building the first fully closed von Neumann machine may be too much.

According to a 1980 NASA study, simple, contemporary bacteria have a complexity of about 10 million bits (see `http://www.zyvex.com/nanotech/selfRepNASA.html`). The NASA study proposed a device to operate on the moon. In that environment, the lunar von Neumann machine might require 10 — 150 gigabytes of 'genome' and even then it might not be fully self-replicating; it might lack 'parts closure'.

Since humans must build the first von Neumann machine, efficiency and cost are issues. It is no good building a von Neumann machine that makes worse use of your land than existing farms and factories. And you cannot build one you cannot afford.

Von Neumann Machines

In the late 1940s, John von Neumann first suggested a modern, robotic self-replicator. Moreover, he calculated how much information a self-reproducing entity would require. This meant figuring out what parts a machine needs if

it is to reproduce. He estimated that the minimal size of a self-replicator's 'blueprints' or 'genome' is 25 – 150 kilobytes.

By extending von Neumann's notion metaphorically, we can think more readily about societies, economies, ecologies, and the origins of life.

Economies, for example, reproduce themselves; in that sense, they are von Neumann machines (see "Societies as Von Neumann Machines", page 47). But people work in economies; economies do not reproduce without human help.

As far as I know, there are no general manufacturing robots that can be manufactured purely by self-directed robots using standard, 'regular sized' industrial components. My sense, which may be wrong, is that current investors, whether government or private, would have to spend a huge sum to build the first instance of such a manufacturing system.

We humans are entities that consume 'modules' that are not identical — some foods taste differently than others. Reproduction from large, non-identical, breakable 'components' is difficult. That is what a von Neumann machine that works with 'regular sized' components will have to do. For example, it will mine ore that is an ill-defined mixture.

Very small, 'nano-sized' von Neumann machines are not yet possible to build. If built, these as-yet imaginary, 'nanotech self-assemblers' would put together atoms. These are small, identical, unbreakable components (see "Unbreakable", page 40). Molecules are not identical because the atoms of the same kind that make them up may have different weights. For example, carbon atoms come in two different stable weights. Not counting the different weights of oxygen, the carbon dioxide that plants inhale comes in different weights. Plants prefer the lighter carbon. However, small molecules are often similar, or similar enough, and are made from unbreakable atoms, so they are important. Large molecules may not only weight differently, but fold differently.

Aspects of a von Neumann machine

Like any living entity, a von Neumann machine must **eat**, which means it must gather energy and other inputs.

In order to eat and live, a von Neumann machine must be able distinguish useful inputs from poisons; it must be able to **see** (or smell, taste, feel, or hear) potential food.

This means the machine not only needs appropriate sensors, but the ability to understand and act upon the information. It needs **eyes**, a **brain**, and **hands**.

In a small, 'nano' von Neumann machine, thermal motion brings atoms and molecules to a site. Most often, only the appropriate atom or molecule settles in the site. Most others do not fit. (The others that do fit create variations.)

Unless you think of the process of 'fitting' as a combination of sensing, analysis, and action, you will not consider these entities as having 'eyes', 'brain', or 'hand' at all. However, the process is similar, but more condensed: input that fits is both identified (perhaps wrongly) and accepted by that action.

The inputs, whether energy or material, must be transformed to enable the original von Neumann machine to continue and to enable that machine to reproduce.

In order to continue, the machine must be able not only to provide itself with enough **food** — enough energy and materials, it must also be able to **ward off illness** — to defend itself, and **to heal itself** — to repair itself.

Moreover, the machine must be able to dump materials and energy it no longer uses. It must be able to **excrete**. Some of this excreta will be useless to us. It will be 'pollution'. We will want other excreta, manufactured 'goods'. This will be what we humans say the machine 'produces'.

All in all, a von Neumann machine has a minimum of nine different aspects:

- Energy and material **inputs**, or 'food',
- **sensors**, or 'eyes, ears, and nose',
- **processors**, or 'brains',
- **effectors**, or 'arms', of various types. These are hands that gather materials, perhaps by mining, or are solar collectors that transform light into electricity. Effectors manufacture new systems, repair old systems, defend the machine and its parts, and move materials and energy that is no longer needed out of the machine, as excreta (some of which may be what human harvest).
- Effectors need to make use of **internal transport and communications**, a 'circulatory system'. Although in some ways, an internal transport and communications system consists simply of different kinds of effectors, people tend to categorize transport and communications differently.
- Similarly **manufacturing**, or 'metabolism', takes place because of effectors, but people think of a 'metabolism' as different. This includes the 'metabolism' or manufacturing needed to reproduce.
- In order to maintain oneself, or reproduce descendants, 'blueprints', or a 'genome', or **design data** must be kept.
- The **border** may simply be the line dividing the machine from the rest of the universe, a concept, or it may be a 'skin' with barriers or other effectors that serve as defense.
- Finally, a machine produces **outputs**, including waste heat, and materials. Humans will dislike some outputs, the 'pollutants', and will like others, the 'economic goods'.

A von Neumann machine can reproduce exactly or with errors. Even though errors are common, it is possible to reduce the end number through appropriate 'error correction' techniques.

Natural selection requires that descendants show variation, either as the result of sex or of reduplication errors. When reproduction is accompanied by error or variation, the set of re-duplicated descendants includes a mix of entities. Of that mix, a few will more tightly reproduce the design of the original manufacturer and others will more loosely reproduce that design.

Those descendants that do better in the circumstances in which they find themselves — which may be different from the original circumstances — will be more likely to reproduce themselves into another generation, and thus, probabilistically speaking, be more likely to pass on their design data to their descendants.

On the one hand, the 'error' or 'variation' aspect of reproduction is important, since it means that different circumstances are met by von Neumann machines with different capabilities. For natural selection to succeed, new instances with different capabilities must appear.

On the other hand, the amount of 'error' or 'variation' cannot be too great, since circumstances seldom change dramatically and if the 'error' or 'variation' is too great, too few of the different entities will reproduce. Hence, internal error correction mechanisms must operate.

Humans may not want machines with new capabilities. Hence humans may well design machines with very strong internal error correction mechanisms. In addition, humans are not likely to introduce auto-variation mechanisms or sex, and they are likely to produce tests to make sure that newly produced machines are similar to older ones.

But without humans around, you may end up with a mechanical ecology like that described in James P. Hogan's 1983 science fiction novel, *Code of the Lifemaker*[1].

Build with Unbreakable Components

Both numbers and, in ordinary life, atoms are unbreakable. They can be combined into large assemblies. But when the assemblies grow very large, they break.

We are familiar with unbreakable concepts: the number three is unbreakable. Unlike the wooden hull of a sailing ship or the metal bearings of a car, a number cannot wear out. A sailing ship or car may last for years; but eventually both break. Unless fixed, they cease to work.

[1] *Code of the Lifemaker*,
1983, James P. Hogan,
Del Rey (1984), ISBN 0345305493,
Baen Books (2002), ISBN 0743435265
(see `http://en.wikipedia.org/wiki/Code_of_the_Lifemaker`)

Computer programs are built from mathematical objects. The components are unbreakable. Moreover, every similar component is exactly identical, not 'nearly' identical, as with screws or hard drives. Exact similarity enables developers to create complex entities, with thousands or millions of lines of code. It is much harder to build physical objects out of nearly identical but not quite identical objects.

However, as we well know, the components of a computer program can be combined wrongly, or the programmer can insert the wrong components, or leave them out. Or one aspect may unexpectedly influence another.

Even when we start with components that are unbreakable, we rapidly create objects that break.

Nature does the same. It creates substances that rot.

In the kind of circumstances conducive to our kind of life, atoms are unbreakable. Under the conditions we humans live, you cannot add to or split off part of an atom or fission it in two.

Moreover, atoms of the same kind are nearly identical. Different isotopes of the same kind weight differently. They move at different speeds at the same temperature, and their spectra are slightly different. However, isotopes are identical. Their differences come from differences in locations and velocities, as well as from the energy and number of their electrons.

Living organisms started with atoms a very long time ago. They survived and multiplied in 'friendly' environments — environments without too many strong ultraviolet photons breaking molecules, with enough thermal energy to move components around, with many water molecules, with photons of the right energy or molecules of the right sort for energy transfer and so on. These kinds of environments, while rare in the universe at large, were frequently available on earth.

Because atoms were unbreakable, and molecules always break in the same ways, early self-replicators did not have to deal with 'worn' or 'rotten' parts. The early self-replicators did have to deal with simple molecules, such as carbon dioxide, that were nearly similar to each other, but weigh differently. Fortunately, dealing with these problems was not too hard.

Either a molecule was right for its task, or it was not. Only after organisms became more complex did rotten or otherwise inadequate substances become a problem. Such substances are like complex computer programs. They contain the biological equivalent of computer bugs. A rotten substance may contain the wrong atoms, or lack the right ones, or contain atoms wrongly combined. Its complexity becomes so large that the unbreakable nature of its components becomes irrelevant.

In human societies, sacred postulates are also unbreakable. As Roy Rappaport[2] said in *Ecology, Meaning and Religion*, rituals bring into being certain states of affairs. *When authorized persons declare peace in a proper*

[2] *Ecology, Meaning and Religion*, by Roy A. Rappaport,

manner, peace is declared whether or not the antagonists are persuaded to comply. (Page 189)

In addition, Rappaport noted that these states of affairs are judged according to criteria that are provided by rituals. If *a man is properly dubbed to a knighthood and then violates the code of chivalry, . . . we do not say that the dubbing was faulty,* but that the knight is faulty. The state of affairs created by a ritual is judged *by the degree to which it conforms to the stipulations of the ritual.* (Page 189)

Laws also are built from unbreakable components, like the admonition not to murder your neighbor. When we say that a man 'broke the law', we mean that the man did something wrong, not that the law broke into little pieces, like a smashed stone.

In complex organisms, the nature of the unbreakable component may become irrelevant. The same happens as the body of law becomes more complex. For example, this occurs when lawyers circle around the legal definition of 'neighbor'. Is the person breaking into your house at night a neighbor or a thief? What rights and obligations do you have towards him? If you kill the intruder, are you doing wrong? Have you murdered your neighbor, or did you defend yourself rightly?

The as-yet imaginary, human-made, extremely small self-replicators, the nanotechnological self-assemblers will work with atoms.

Incidentally, we do know that 'nano von Neumann machines' exist although we cannot yet construct them: we call them 'bacteria'.

Although the first human-made, nano-sized self-assemblers may have a complexity no larger than a very early proto-bacterium, a complexity of 25 — 150 kilobytes, I expect them soon to become as complex as more recent bacteria, and perhaps more so.

Entities stop becoming more complex, stop becoming more prey to rot, only when the complexity or rot kills enough of them.

Darwin's Five Laws of Evolution

Darwin explained how complex design and function can come to exist without a designer. He described what happens within a system of entities that replicate but with some replication errors and with some error correction.

People tend to think of his work as an answer to the old question of where design comes from when there is no specific design entity.

1979, North Atlantic Books,
ISBN 0-913028-54-1 paperback

For example, in his *Timaeus*[3], Plato introduces the notion of a 'craftsman' who creates the universe as we know it.

The English language favors this notion by making the usual term for 'that which designs' be the word 'designer'. This is similar to the construction of 'writer' out of 'write', of 'composer' out of 'compose', and 'builder' out of 'build'.

The linguistic convention often works with people. Two hundred years ago, computers were people who computed, not machines. But the linguistic transform failed thousands of years ago when it caused people to think that a 'design' needed an entity as a 'designer'. It failed even though everyone understood that individuals were different from one another and that some of the differences, but not all, were passed on to children.

When Charles Darwin first proposed his hypotheses a century and a half ago, he saw them as one conjoined notion. And he saw them as applying to biology, not anything else. With the supporting evidence he provided, he and others could describe that notion as a theory, Darwin's Theory of Evolution.

However, as Ernst Mayr pointed out[4], Darwin's notion has five parts, only one of which was accepted by all the evolutionists of his time: that part was the conclusion that the world is neither constant nor recently created, nor does it pass through cycles which repeat, but that it changes and that entities that live on it change, too.

Mayr's distinctions are especially important nowadays, since Darwin's Laws apply both to biology and to other situations in which entities reproduce with variations and then that proliferation is pruned.

Darwin's colleagues rejected various components of his theory either because they flew in the face of cultural beliefs, because of lack of conclusive evidence, or because of some combination of factors. However, in the time since Darwin first proposed his hypotheses, all five components have been proved in simulations, observations, and experiments.

Hence rather than call Darwin's ideas a theory or group of theories, it is better, more conventional, and more polite to refer to them as natural laws. They are, after all, as well established as Newton's Laws, which we all know, are broken under certain circumstances, but which hold well enough.

---

[3] *Timaeus*,
translated with notes by Peter Kalkavage,
2001, Focus Publishing,
ISBN 1-58510-007-2

[4] *One Long Argument*,
Ernst Mayr,
1991, Harvard University Press, p. 36
ISBN 0-674-63905-7 hardback
ISBN 0-674-63906-5 paperback

Darwin's Five Laws are:

- **Evolution as such**

  Evolution as such comes from the understanding that the world is not constant. It was not recently created; it is not cycling. The world changes. Moreover, the types of entities that live on it also change. (This involves a view of history in which time is linear, a way of thinking that merchants adopted centuries ago. See "Middle Ages Accounting", page 31.)

  Not only is the understanding of 'evolution as such' important to biology, it is important for those deciding how to build a von Neumann machine. I suspect that humans will not want machines that evolve new capabilities. (Science fiction writers, such as Gregory Benford[5], have written stories of machines that may evolve to kill us.)

  Leaving aside questions of human design, a change in entities contradicts the 'common sense' notion that different animals and plants each has its own 'essence'. This notion has been prevalent in Western society since the ancient Greeks. Its implication was that one species could not change to another any more than a triangle could change to a square.

  You only had to look at a cat and a dog and ask how one could change into the other. Nowadays, we do not think of a cat changing into a dog, but ask about a common ancestor of both, from a time long before cats and dogs appeared.

- **Natural selection**

  Natural selection is the understanding that individuals in every generation differ from one another, or, at least that some of them do. In every generation some individuals survive and reproduce better than others. Their genes multiply.

  This is the key idea: natural reproduction is not perfect.

- **Multiplication of species**

  Multiplication of species is the understanding that species either split into or bud off other species. Because different ecological niches provide different ways for an animal or plant to live — provide different 'professions' — and because blueprints do not copy perfectly, different plants and come to fill different niches, with different shapes and behaviors.

  In biology, multiplication often occurs after some members of a founder species become isolated from the rest. Those of their descendants who are adapted to the new place are more likely to survive compared to those who are adapted to the old conditions.

[5] *In the Ocean of Night*,
Gregory Benford,
originally published in 1977, Aspect, 2004,
ISBN 044661159X paperback

From the point of view of someone funding the construction of the first von Neumann machine, multiplication provides a reason for extremely strong error correction.

- **Gradualism**

  Gradualism is the understanding that changes take place through a gradual change of population rather than the sudden production of new individuals.

  'Gradual' is a relative word. In discussions of 'punctuated equilibria', I have heard people talk of one species replacing another in the 'blink of an eye'. What they meant was a time period that is many times as long as written human history. The 'blink' might last 100,000 years. In human terms, this is a long time. But in geological terms, 100,000 years is short. Hence the use of the phrase. But to humans, a change over 100,000 years or over merely 10,000 years, seems gradual.

  Put another way, gradualists claim that it is unlikely that starting tomorrow at 9 am, all humans born would possess green skins and lay large, hard shelled eggs.

  The concept of gradualism as two effects.

  The first is to point people away from a presumption that concerns a farmer: efficiency. A farmer asks whether one action or other is better for the farmer.

  But a process that depends on one group of offspring enjoying higher survival and reproductive rates than others is not asking which is better: indeed, a mindless process cannot ask.

  But humans do ask, and the questions they ask are influenced by their concerns. One purpose of the notion is to prevent people from misapplying ideas of efficiency to a process for which that notion is irrelevant.

  As second effect of the concept is to counter a belief that change is easy and involves few variables. In practice, a sudden production of new individuals, a 'saltation', involves a huge number of changes, most of them in the invisible innards of an individual. Since Darwinian change occurs by accident, we are not likely to see the combination of many changes all at once.

  On the other hand, a Lamarckian change can involve many variables. That is why human culture changes so quickly. If they are not prevented, as I expect they will be, von Neumann machines could change this way, too.

- **Common descent**

  Common descent is the understanding that every group of living entities that we know of on this planet descended from a common ancestor.

  This understanding does not apply to the lineages of von Neumann machines when they are started by different builders, but it does apply within a lineage.

However, no one has yet found regular biological entities on this planet that are not descended from one ancestor.

At the time Darwin wrote, many evolutionists thought of animals and plants as being like humans. They asked whether an adult proto-giraffe could stretch its neck to reach higher leaves, and pass on a longer neck to its children, much as human parents pass on a language to their children.

This form of change is called Lamarckianism. Human culture is invented by people and passed on by parents to their children. It is Lamarckian. But the looks and actions of animals, at least those without culture of their own, are passed on genetically. A parent's action does not influence the looks and actions of the child. Only changes in the egg change the child.

(This understanding, by the way, answers the age-old question, 'which came first, the chicken or the egg?' The egg came first, because it contains the part that changed. The egg was laid by a non- or pre-chicken entity; the egg grew up to be a chicken.)

Like humans, if provided with a mechanism, von Neumann machines could copy newly gained knowledge to their children,

(My hunch is that the notion of common descent will fade; but that people will find the others useful for centuries to come, just as Newton's Laws are useful when considering planets, and Aristotle's useful when moving heavy stones. By the way, speaking in defense of Aristotle, I can tell you from personal experience that heavy stones stop moving when you stop pushing. Worse, dropped stones seek the center of the earth, even if your toe is in the way!)

Differing Virtues

Virtue is always the deciding factor, virtue meaning 'most fitted to survive in the environment'. However, the salient virtue changes whether the surroundings are full of the same entities or empty.

A plant, animal, human society, or product may reduplicate prolifically so long as it is alone. But it may not survive competition from its own kind. Different circumstances lead to different virtues.

In any ecology, a period of non-competitive growth comes first. This period lasts so long as unfilled space remains. For plants and animals, 'space' means niches, for businesses, it means markets. For humans it means empty land suitable for colonization. In this period, those that do best reproduce the fastest.

But the deciding capability, the 'limiting factor', changes when all niches are filled. In a 'full' ecology, or 'saturated' market, a plant, animal, human society, or product will be able to reproduce only so long as it can survive competition with others of its own kind.

Consider the initial human settlement of Europe, Asia, and the Americas. Prolific and peaceful humans ranged widely over an empty territory. They cooperated with each other. But when these people met thugs, they would be killed, unless they learned to kill.

'Empty territory' means, of course, 'empty' at the level of the ingressing humans' technological and pathological capabilities. As Jared Diamond[6] wrote, the Spanish conquered what is now called 'Latin America' in the 1500s. The Spanish had steel and their soldiers knew about deceit and double-dealing. The first European settlers in Massachusetts, the Pilgrims, found that before they arrived in 1621 most of the indigenous people had died. The indigenous peoples had caught disease from the many Europeans who had visited the shores for fishing or from people who caught diseases indirectly from the distant Spanish. European settlers were accustomed to these diseases. Some of their children died from them; but other European children fell ill, recovered, and enjoyed immunity as adults.

Put simply, whether it be a plant, an animal, a human society, or a commercial product, an entity may do well so long at it does not have to compete with others of its own kind. But when it does compete, if it cannot handle such competition, it and its kind will die.

Societies as Von Neumann Machines

Although you can think of von Neumann machines as ecologies or species, human societies fit the criteria, too (see "von Neumann Machines", page 37). On the one hand, this notion is straightforward and obvious; on the other hand, by thinking of societies as von Neumann machines, we can think differently about them than usual.

Let us go back to human beginnings: the earliest societies taught their children how to duplicate, more or less, what the elders did, both to support themselves physically, with food, clothing, and shelter, and culturally, with religion, law, and humor.

We can think of a society metaphorically as a ship with a crew, a 'ship of state', or as an animal, such as a bear, or as an uncle. Likewise, we can think of a society as a complex, self-reproducing machine with sensors, blueprints, energy requirements, and effectors; or in more biological language, with eyes and ears, with a genome, with food requirements, and hands.

Moreover, we know that inexact duplication leads to evolution (or extinction). Humans pass on genes through sex; they pass on knowledge and culture through words and actions. Consequently, in a social von Neumann machine, inheritance is both Darwinian and Lamarckian. 'Memes' are important as well as 'genes'.

---

[6] *Guns, Germs, and Steel: The Fates of Human Societies*,
Jared Diamond,
1997, W. W. Norton and Co.,
ISBN 0-393-03894-2

Ancient societies took a long time to replicate: they reproduced themselves once per generation, with some parts taking longer, such as shelters. They added little from century to century. Mostly, people replaced what was worn out.

In the modern world, we do not think merely of reproducing a society, but of adding to it: of adding cultural and built goods to it, and of reducing its bads, such as pollution and injustice.

As of 2000, the fastest self-replicating social systems are economies that duplicate their economic output in seven years, a 10% per year growth rate. This sort of number is not exact: along with the goods that are measured to double in seven years come bads, which are often not measured.

(For a 'conventional' von Neumann machine, such as a robotic factory, the replication goal seems to be for a reproduction time of a few months, a few weeks, or even less. See `http://www.rattlesnake.com/notions/sudden-technology.html`.)

A von Neumann machine consists of parts. These can be used to analyze the various parts of an economic and social system:

- The central processor, or 'brain'

  In a economic or social system, the 'brain' of a von Neumann machine consists of the people who make the decisions that influence the whole society, such as poets and engineers, a few generals, a few of the rich, and some politicians.

  In science fiction novels, writers have suggested societies in which computers make many or all the decisions.

- Sensors, or 'eyes, ears, and nose'

  In society, sensor information, what you see, hear, smell, taste, and touch, is transformed into reports for others. In the past, reports were almost always anecdotal. Sailors and spies, people who loved strangers, told stories about their adventures abroad (see `http://www.rattlesnake.com/notions/xeno-savy.html`). People at home told of the conditions and situations with which they were familiar.

  Nowadays, some reports come as statistics about production and surveys of people. Collection and presentation can be, although it often is not, designed to reduce the dangers of bias and selection.

- Blueprints, or 'genome'

  A society reproduces itself by reproducing its religion, ritual, law, methods of cultivating land, making shelter and clothes, by reproducing its knowledge, habits, and characteristics, as well as by reproducing its physical embodiment, whether people or houses.

  In the past, much information resided in ritual and tacit knowledge, or else in a mysterious biological inheritance. Nowadays, more is known and more is written explicitly.

- Internal transport and communications, the 'circulatory system'

  Paths, roads, railroads, telephones, shipping lanes, and the Internet all make up the 'circulatory system' of a modern country. In the past, roads were few and paths perilous. Only shipping was relatively inexpensive and then only over the past 10 millennia.

- Manufacturing, or 'metabolism'

  These are ways of making, of building, of growing food.

  Each era has its own technology. 2000 years ago, drinking vessels were made of bronze. They were called 'bronzes'. But as glass making become more widespread, people began to drink from 'glasses'.

  Over the past two centuries, manufacturing technology has changed and changed again. Now, many items cost less to produce than before. Most people like this increase in material wealth, even when it comes with new forms of injustice and new or more imposing pollution.

  (Often people in a government or ruling circle choose a method that is not so unpleasant for them, but is dreadful for ordinary people. People in a ruling circle, for example, may figure that they will always live in rooms with filtered air, and not care about the air pollution that sickens ordinary people.)

  Another side effect has to do with conceptions of justice. Not all, but a part of a feeling of justice comes from what people learned as children: the 'right way' to act. With changes in technology, the 'right way' can become the 'wrong way'. Thus, in the past, many people lived in villages. In a village the way to ensure economic and social security is different from the way to ensure it in a city. The patterns of the one do not scale to that of the other (see `http://www.teak.cc/softfree/software-freedom.html#Software%20Dangers`).

- Borders, or 'skin', the barriers against outsiders

  At the end of World War I, the victors created several new countries in Eastern Europe. One method — one that did not always succeed — was to draw a national border along a linguistic border. Differing languages do present a barrier, as do differing rituals and customs.

- Effectors, or 'arms', which can build or make

  In the past, people used fire and wind and human and animal strength. Fire was important to the non-human ecology as well as to humans. Wind power had less impact on society than the human and animal action needed to grow food and make clothing. And neither human nor animal action had much impact on the world.

  Now, modern technology provides for vastly different and more powerful effectors, like bulldozers. Already, humans move about as much earth each year as nature does with wind and water.

- Energy sources, or 'food'

  Most past energy sources, such as grain for eating, hay for horses, or wood for burning, gained their energy through 'low energy density' transformations. All had to be grown.

  Many modern 'alternative energy sources' are similar: the sun's rays, wind, waves ... Only uranium fueled nuclear power plants and as yet unbuilt hydrogen or hydrogen-boron nuclear fusion plants are alternatives that make use of 'high energy density' transformations (see `http://www.rattlesnake.com/notions/energy-alternate-essence.html`).

  But mainstream contemporary energy sources, oil, natural gas, and coal, have 'high energy densities'. (Their beginnings did not; but that is so long ago, few think of them.)

- 'Pollution', or excreted material

  Human excreted material is not necessarily polluting. But it has to be handled with care, for without good sewer systems, people fall ill from infection.

  The materials excreted from the non-human part of our von Neumann machines are worse. No one has yet figured out how to make much use of many side effects of agriculture, of metal mining and refining, of logging, or of burning coal, gas, and oil. The only remedy seen so far is to figure out a different way of doing the job, or of not doing the job.

  In the old days, the side effects could be as bad as they are now. The ancient deforestation of the Mediterranean region was as bad as recent deforestation. But most side effects were too small to cause much trouble. The 'bads' could go into the river and be diluted, or into the air. A smaller area was deforested. Nowadays, the amounts of bad are large.

In old times a society might survive without full 'parts closure' (see "von_Neumann_machines-parts-closure", page 37) — it could gain new ideas, new techniques, and new blood from a neighboring but different society. In the present, in so far as you think of the Earth as being made up of various von Neumann machines, each society enjoys even less 'parts closure'. But if you think of the present Earth as one segmented, but entire von Neumann machine, we either enjoy complete 'parts closure' or we are dying.

In so far as we are mining coal, oil, and natural gas, and not engaging in sustainable activities, we are dying. We are a von Neumann machine that cannot quite reproduce itself exactly, but which can reproduce itself well enough to carry on for a time.

The process of dying can go on for a long time. One generation can succeed another. I remember moving to a new house when I was young. On its land, my father found an old dump with car parts in it. He learned the story and told it to me: a previous owner had kept taking apart his car. Every time he did this, he also put it back together again. But each time, he found leftover parts. Those he threw in the dump. But the car kept running.

Whatever he threw out was not really necessary. The car lasted a good long time. But, eventually, it stopped. (For more on resource limitations, see `http://www.rattlesnake.com/notions/outcasts.html`)

A Species is Not an Organism

Sometimes, I speak of a species as one organism. But it is not. A species is a collection of organisms that evolved according to Darwin's Five Laws (see "Five Laws", page 42).

Nonetheless, sometimes the 'one organism' metaphor is useful. Just as an organism needs to eat and reproduce, so does a species.

Sadly, the metaphor may also be misleading. A friend of mine recently employed the metaphor to argue against human wars: just as one leg in a human should not fight the other, so one country should not fight another. According to the metaphor, humanity as a species was like a single organism.

However, under various circumstances, species' virtues are different from organisms' (see "Differing Virtues", page 46).

This is not to say that metaphors cannot be useful. They are. More to the point, we often understand and experience one kind of thing in terms of another.

More abstractly, George Lakoff and his collaborator, Rafael E. Nez[7], wrote in reference to mathematics (see "Understanding Without Proof", page 66) that metaphors are a

> *. . . a cognitive mechanism for allowing us to reason about one kind of thing as if it were another.*

The key is to separate the map from the territory: to understand that much of our understanding comes through metaphor, and that metaphor is useful, but also dangerous.

Just as it is useful to think of either a single human society or a group of human societies as a von Neumann machine it is useful to think of an organism or a species the same way (see "Societies as Von Neumann Machines", page 47). It is easier to think more clearly about an imaginary self-replicating, robotic factory than to think of your own society or of your food supply.

When you imagine an ecology as consisting of many self-replicating, robotic factories[8], the mapping is straightforward. Each biological organ-

---

[7] *Where Mathematics Comes From: How the Embodied Mind Brings Mathematics into Being*, George Lakoff and Rafael E. Nez, 2000, Basic Books, page 6 ISBN 0-465-03770-4

[8] *Code of the Lifemaker*, 1983, James P. Hogan, Del Rey (1984), ISBN 0345305493,

ism is equivalent to a self-replicating, robotic factory, or equivalent to two such factories that must cooperate to reproduce.

The correspondence is somewhat less straightforward when you imagine a complete species as a von Neumann machine. The correspondence becomes even more distant when you imagine a complete ecology, made up of many species, as one self-replicating, robotic factory.

Baen Books (2002), ISBN 0743435265
(see `http://en.wikipedia.org/wiki/Code_of_the_Lifemaker`)

Words, Money, and Guns

Influence comes from three sources: words, money, and guns.

By words, I mean the ideas that influence people. The ideas of the rule of law, of some personal freedom, of the right to choose which power group to support — these are all very influential. They lead to peaceful methods of settling disputes with strangers, which is very civilized. They are competing against or sometimes in harmony with ideas that people should be godly, helpful to neighbors, uncorrupt, and hard working, as among the early Taliban in Afghanistan.

By money, I mean the ability of a government to fund those it supports. Much of Britain's power as an empire came from this; for example, in the wars of the Spanish Succession, some British fought, but much of Britain's power came from its ability to pay others. Nowadays, much pay goes through international organizations, such as the IMF or World Bank; or goes via private investments after the IMF has, in effect, provided a 'seal of approval'. These are more sophisticated managerial techniques than many in the past. They provide other players with more power, and enable a great power, such as the United States, to retreat gently as needed, by simply cutting the money it spends.

By guns, I mean military power, and the perceived willingness to use it. With the appropriate advanced technology, military power comes more cheaply. Moreover, the technology need not be one's own. None of the suicide soldiers who hijacked jets and then crashed them into the World Trade Center and the Pentagon on 2001 September 11 came from regions that could build such aircraft. But they could use them.

Without the technology that enabled them to travel to so distant a land and then cause so much damage, the September 11 hijackers would have been able to kill only a few who lived close to home.

It goes without saying that suicide soldiers need to persuade themselves that their actions were right. Words are key, as well as technology.

Soldiers from richer states need not have such strong beliefs. Rather than intend to kill themselves in a battle, they can fight with the weaker belief required to risk themselves.

As for the future:

First, consider a country: what happens when the Chinese ability to buy technology, to fund foreign projects, and pay for foreign wars, comes to exceed that of the United States? In these circumstances, the powers that be in China need not develop the words that lead to extremely strong beliefs, only those that are common in almost all armies.

The Chinese have historic grievances, a desire to look good in their own eyes, and long horizons (by 'Chinese', I mean, the powerful in the country).

In times past, other countries have not readily assented to the requests of countries whose power has increased, so the newly powerful countries have

often tried to redefine power relationships via war. In the case of Germany, it did this after its economy grew bigger than its main European opponents in the years before World War I, but before its economy grew bigger than the coalition that raised against it.

This rendition of history suggests that eventually, China will seek power over what is now called a 'rebellious province' and over other nearby countries; either those countries will assent peacefully, or they will not. In the latter case, we may see war.

Second, consider people who share a belief, but not necessarily a country. With the decreasing costs associated with advances in technology, non-governmental organizations can afford to engage in war. Enough money is there.

If fought against a rich country, the war will be asymmetrical. Since asymmetrical war means that more people on the weaker side must die, words — which create beliefs — become important. Could his opponents have overthrown the government of the Shah of Iran without strong beliefs, without sufficient funding, and without the modern technology of cassette tapes to spread the beliefs? I doubt it.

Historically, wars generally occur when two (or more) countries or organizations disagree over their relative power. When they agree, they negotiate; the weaker acquiesces peacefully. (Since it forgoes the costs of war, the surrendering side may well retain considerable benefits.) But when countries or organizations disagree, they fight. For example, in the 1960s and 70s, powers in Vietnam and powers in the U. S. disagreed over who could outlast whom in a war of attrition. The U. S. lost.

The great advantage of democratic arrangements, both domestically and internationally, is that they permit rearrangements of power without war. Fundamentally that is what the European union is about: a way for France and Germany to readjust to each other without having to fight.

Actions of Government

A government must undertake various actions whether it be currently existing or new.

Every human action has its **predisposing**, **precipitating**, and **perpetuating** causes. This is a useful, and for English speakers, alliterative list. It reminds you to look not merely at the immediate or precipitating causes of an event, but at whatever predisposed the event to happen, and at what keeps it going, its perpetuating causes.

Moreover, a concept can be paired with each cause to stop an action:

- **preclude** a predisposing cause, such as deforestation,
- **prevent** a precipitating cause, such as an attack that goes around existing defenses, and,
- **preempt** a perpetuating cause, such as discrimination from generation to generation.

First of all, a government must avoid making disastrous decisions; then it must decide on several down-to-earth goals; and in any event, it must deal with those who attack it in ways that do not fit traditional European categories, deal with changes in climate, and deal with databases.

However, there are some actions a government cannot do, some it will do wrongly, and some it can do.

"Can't Do", "Wrongly Do", and "Can Do"

People view government has having one of three different spirits: "can't do", "wrongly do", and "can do".

- '`can't do`' **Government is the problem**

  The thesis is that governments will fail to act or will act confused.

  In particular, this notion means that people must depend on themselves and on nearby people such as family, friends, clan, or distant relatives, businesses not involved in government, religious organizations not involved in government, and other non-governmental organizations.

- '`wrongly do`' **Government will make mistakes**

  This is not a claim that governments will fail to act or act confusedly. Rather, it is a claim that governments will act coherently, but wrongly.

  The concept means that cops, soldiers, and those more powerful in government will do wrong and should be avoided.

  An example comes from New Orleans, Louisiana, which was flooded by a hurricane in August 2005. Not everyone evacuated by car. Some tried to walk out of the city but were prevented from doing so by armed police. This was an action that those who gave the orders thought was right but which those in New Orleans trying to escape figured was wrong.

- ‘`can do`’ **Government will do well**

  This is the ‘can do’ thesis exemplified by the Seabees. (The Seabees were U. S. military ‘Sea Construction Battalions’ that became famous in World War II for their rapid and successful work building or rebuilding airfields and the like.)

  Obviously, doing well is hard and expensive. For one, nothing will happen exactly as expected.

  Successful action requires good planning, training, and exercises. The wrong planning – perhaps because of a mistaken view of generalities – can fail, as can inadequate training or exercise.

  Moreover, a rare or as yet non-existent event can lead to mistakes over what should be planned, even if the powers-that-be have a realistic view of probabilities in the world, or lead to corruption.

  Thus, for hurricanes, for success with the ‘can do’ spirit, people in governments need to:

  - hire professionals to focus on what might be done
  - fund meaningful training and exercises
  - insist that the professionals learn about probabilities and the like so as to be able to make good decisions when a hurricane is reported

There is more. It is hard to do well. “Wrongly do” is not an unwise expectation.

And for emergencies, these “typically” do not happen during a (randomly chosen) short period of time, but over a long period, they “normally” do.

Moreover, in emergencies experts should or do use a “pattern-recognition decision-making process” in time-critical situations rather than a more time consuming “reason-from-the-data process”.

Of course, a decision-making process based on pattern-recognition means a great deal of expensive, realistic training and exercises beforehand. That way, those who make decisions can learn to see the patterns and decide on them correctly, often enough. It does no good having someone make decisions quickly and erroneously.

Otherwise, they “do wrongly”.

An advantage of a reason-from-the-data decision-making process is that it will be correct (in the sense of offering the highest certainty for the options), if the data and the reasoning are both good.

A second advantage, very important, is that a reason-from-the-data decision-making process costs less. It is still expensive and you must invest in getting the data and in training previously educated people for the task at hand. Nonetheless the cost is less than for decision-making based on pattern-recognition.

For pattern-recognition-based decision-making, you not only have to obtain the data and train the people (who have already enjoyed a good general

education, which is expensive for a society), you also need to give them a great deal of additional training and exercises.

In any case, we can try to judge how a particular set of men and women will do, or fail to do, or wrongly do if they form a government.

We can judge certain situations confidently. Thus, expect that a pre-industrial government will do little that is helpful in a hurricane. This is because it lacks knowledge about sensors, it lacks the people to deal with them, it lacks a decent emergency force, it lacks funds . . .

Similarly, while many early industrial governments had the ability to raise taxes and fund what is necessary, the people in those governments may have misunderstood what could be done or how to do it.

No one lofted weather satellites until the 1960s. An early industrial government could not predict hurricanes. But it could act smartly in preparing for the "atypical" but "normal" event of a hurricane, and it could act smartly after a hurricane.

Nowadays, hurricanes can be detected early and predicted somewhat. This makes early action a bit easier, but still, doing well is hard.

(Incidentally, some argue that in the U. S. in 2005 right wing romantics are against 'can learn' studies because they fear people might talk about what flooding could happen again to New Orleans if it is rebuilt as it was, where it was. These people expect a "can't do" government: a government that will act confusedly when it tries to act.

(At the same time in the U. S., it is argued that left wing romantics are against 'can do' engineering because they expect governments and other large organizations to rebuild New Orleans as it was, where it was. These people expect a "wrongly do" government: a government that will remake a known mistake when it tries to act.)

Nonetheless, in some societies, at least for a time, many people see and exemplify the "can do" spirit.

Disastrous Decisions

First, consider societies that made disastrous decisions in the past.

Jared Diamond[1] has written a book, *Collapse: How Societies Choose to Fail or Succeed*, on this theme. Before publishing his book, in March 2003, he asked why societies can make disastrous decisions? (See `http://www.edge.org/documents/archive/edge114.html`.)

Diamond spoke of *four somewhat fuzzily delineated categories*:

- failure to **anticipate** a problem;

[1] *Collapse:*
How Societies Choose to Fail or Succeed,
Jared Diamond,
2005, Viking,
ISBN 0-670-03337-5

- failure to **perceive** a problem that exists;
- failure to **try to solve** a problem;
- failure to **solve** a problem after trying.

The first two reasons do not fit the "can't do", "wrongly do", and "can do" classification, because the society did "not do". The third is an instance of "can't do". The fourth is an instance of "can do" that failed, that is to say, of "wrongly do".

The **failure to anticipate** a problem may come from any one of several sources. First of all, failure to anticipate may come from *lack of experience*. For example, in north western Europe and the eastern part of the United States, trees that fall down into the understory rot away. In the U. S. west, however, they can accumulate into a huge load of fuel and lead to a much larger fire than any in the east of the U. S.

Second, a society may fail to anticipate a problem because it *cannot preserve the memories* of events that happened generations before. For example, the Classic Lowland Maya had writing, but did not use it to record drought. When drought came they could not draw on any earlier experience.

Finally, a society may fail to anticipate a problem because the people within it reason by way of a *false analogy* or misleading metaphor (`http://www.teak.cc/softfree/software-freedom.html#Misleading%20Metaphors`). (For more about metaphor, see "Understanding Without Proof", page 66.) Diamond uses Iceland as an example: its soil is readily destroyed; but the early Viking settlers thought its soil was like the heavy clay soils of their native Norway. Consequently,

> *. . . [w]ithin a few generations of the Vikings' arriving in Iceland, half of Iceland's top soil had eroded into the ocean.*

The **failure to perceive** a problem that exists may arise because the problem is *imperceptible*. Diamond speaks of nutrient-poor soils with lush vegetation; the nutrients are in the vegetation not the soil. When plants are removed, the nutrients are removed.

A society may fail to perceive a problem that exists because of a *slow trend concealed by wide up-and-down fluctuations*. For example, *the medieval Greenlanders had . . . difficulties in recognizing that the climate was gradually becoming colder . . . .*

Finally, *distant managers*, more common now than in the past, may simply not perceive a problem that is not reported to them. Diamond points out that the largest timber company in the state of Montana is based elsewhere and wonders whether the company executives know they *have a big weed problem on their forest property.*

Even after perceiving a problem, a society may **fail to try** to solve it.

One reason is because of *clashes of interest*. Some may reason accurately that they can advance their own interests by behavior that is harmful to others. Many economists refer to this as a 'rational behavior' since it is rational for individuals, but not the society.

As Diamond says

> *. . . the winners from the bad status quo are typically concentrated (few in number) and highly motivated because they receive big, certain, immediate profits, while the losers are diffuse (the losses are spread over large numbers of individuals) and are unmotivated because they receive only small, uncertain, distant profits from undoing the rational bad behavior of the minority.*

A conflict between *short and long term* outcomes may well come from a clash between individuals or it may come from a clash within each individual.

Societies may also demonstrate 'irrational behavior' that is harmful to everyone because the behavior supports *individuals' deeply held values.* Diamond says that much of Easter Island's deforestation resulted from such deeply held values.

Individually felt terror, anxiety, or sadness may lead to psychological *denial*; and if enough people share the same terror, anxiety, or sadness, individual denial may lead to social denial.

Finally, a society may try to solve a problem and **fail**. As Diamond says

> *The state of Montana loses hundreds of millions of dollars per year in attempting to combat introduced weed species . . . the weeds are too difficult to eliminate at present.*

'Global Warming', a Bigger Danger If Natural

Recently, people have become concerned with 'global warming' or 'climate change'.

In so far as it is caused by human action, global warming is an external side effect of economic action. As with other external 'bads' (see "Needful Government Regulation", page 13), the only way to ensure that society handles them is through governance.

(I think it is well understood that few notice the 'warming' of 'global warming'. It is hard to see a small change in average temperature (see "Disastrous Decisions", page 57). But everyone will notice and pay for worse weather. For example, if a slight increase in average temperature means that more snow melts in the head waters of Siberian rivers, the fresh water entering the North Atlantic could shut down the ocean's thermo-haline circulation. That could cause Britain, France, Germany and the rest of northwestern Europe to freeze like Labrador.)

In July of 2003, U. S. Senator James Inhofe said that
(see `http://inhofe.senate.gov/pressapp/record.cfm?id=206907`)

> *. . . natural variability is the overwhelming factor influencing climate*

and that current climate change does not come from human activity.

I hope he is wrong — most scientists think he is wrong — because if he is right, this means that it is important to act immediately to restrict

humanly produced greenhouse gases, and to do so strongly, in order to try to compensate for damaging and costly natural changes. The mainstream, 'anti-global warming' advice gives us more time and requires less effort.

The greenhouse gases whose output we can control to some extent are carbon dioxide, methane, the nitrous oxides, and the chlorofluorocarbons.

The Senator says that current human inputs of these greenhouse gases do not have much effect, even though they are known to have some influence. If he is right, then to protect us against more natural disasters, we will have to reduce greenhouse gases even more than most scientists suggest. If the tool is weaker, we have to act more strongly. That is the best we can do.

Otherwise, people in Senator Inhofe's home state of Oklahoma, as well as elsewhere, will suffer from droughts, floods, storms, cold spells, and heat waves.

Over the past half century, I have seen a change in local weather — right now, I live only a short distance from where I grew up, so the differences are not geographic. In particular, I have noticed that in winter we tend not to suffer long periods with temperatures below zero degrees Fahrenheit (-18 degrees Celsius) the way we did 40 years ago. This is not to say that we do not suffer cold, just that the cold is less. Similarly, some recent winters were heavy with snow — as one would expect with global warming, since there is more moisture in warmer air. At the same time, I have noticed that a few recent winters have been so warm that we have had more rain than snow.

Summers are different, too. Rather than a few days of very hot and humid weather, we sometimes suffer several weeks of such weather. Other summers seem to have more rain than in the past.

This is personal observation. It is 'strongly suggestive' to me (see "Certainty Factors", page 80). But you may not accept my reports. You will have to decide which reports or which personal observations to accept.

As far as I can determine, it is true that the amount of carbon dioxide in the atmosphere is increasing. I believe the reports. In particular, I have seen a multi-decade graph of the amount of carbon dioxide in the atmosphere (see `http://www.visionlearning.com/library/module_viewer.php?mid=109&l=&c3=`). The amount goes up and down depending on the season (see `http://www.atmosphere.mpg.de/enid/25h.html`). Since the northern hemisphere has more land and people than the southern hemisphere, there is a seasonal difference. But the graph as a whole shows an upward trend.

Clearly, natural variation occurs. The Medieval maximum and the Little Ice Age are famous examples. Senator Inhofe talks about them. More recently, temperatures fell from the 1930s to the 1960s or 1970s. Senator Inhofe has a point. Natural variation has an influence. I simply hope he is wrong for the present change. I hope that the people who complain about humanly produced greenhouse gases are right.

Otherwise, if Senator Inhofe is right, we will have to do more to protect ourselves. Because of technological changes and increases in population and

knowledge and better communications, current human society will not bear climate changes as uncomplainingly as people did in the 12th century.

Interestingly, as a practical political matter, Senator Inhofe, who otherwise supported the U. S. Bush Administration, is going directly against it. At least, that is the conclusion I gain from his statements.

However, Senator Inhofe himself does not come to the same conclusion. Rather than fear drought, flood, storm, cold, or heat, he suggests that we do nothing, and that the U. S. avoid

> *. . . mandatory restrictions on carbon dioxide and other greenhouse emissions . . .*

Senator Inhofe is an example of "cannot do". Others argue that something can be done, perhaps by fertilizing the surface of oceans, perhaps by substituting non-fossil energy sources for fossil energy sources that produce carbon dioxide. These are examples of "can do" or perhaps of "wrongly do".

(In "Aristotle's Three Traditional Branches of Oratory", page 65, I suggest that Senator Inhofe is an Aristotelian, not a modern, a person who does not perceive, and who therefore ends by saying we 'cannot do'.)

Don't Put All Your Eggs in One Basket

Here is a fable about the dangers of computer databases, a danger that a government must face. This is a call for "can do" regarding a danger that not only did not exist in Aristotle's time two millennia ago, but did not exist two generations ago.

Moving Image:

A mime appears, collects [imaginary] eggs and puts them into a basket.

Then the mime transforms into a peasant woman, dressed in 14th century European clothing. She carries a [real] basket full of eggs to a late Medieval market. She trips and her basket and the eggs in it fly out from her, the eggs flying ahead of the basket. Motion stops; the eggs become white streaks that have not yet hit the ground.

Subtitle and/or voice over:

Belgium, May 1940

Moving Image:

German tanks are advancing against Belgium opposition. The tanks come upon a Belgium fortress.

Subtitle and/or voice over:

Fort Eben Emael

Moving Image:

The fortress stops the advancing tanks and troops. It looks impregnable.

Then German troops land on the concrete that is the roof of the fortress in short take off and landing (STOL) aircraft (explosives come in gliders).

The top of the fortress is flat. A few Belgium anti-aircraft troops are posted there. The Germans quickly overwhelm them. The troops inside have no way to shoot those on the roof. The German soldiers use shaped charges to blow holes in the roof. They kill those inside the fortress.

The German Blitzkrieg goes forward.

Subtitle and/or voice over:

Belgium and France surrendered quickly.

Moving Image:

The next scene is Fort Knox, in the United States. The name of the Fort is shown, its gold, guards, and its overall look.

Subtitle and/or voice over:

The United States government stores much of its gold in Fort Knox. So far, no one has stolen the gold. No one as attacked the fort, no one as burgled it, or bribed enough guards, or blackmailed or bamboozled them; no one has been hired those whose beliefs would lead them to take the gold.

A fortress can successfully guard value, so long you guard it well.

Moving Image:

The next scene is a 1950s office with an 'infinite' row of filing cabinets, fading off into the distance. An older man says to a younger man, 'the information is here; all you have to do is find it'.

The younger man pulls open three drawers one after another, looking at folders, then sits down on a chair and goes into a dream. During the dream, the office background fades and the young man transforms into a mime.

The mime opens [an imaginary] cabinet and pulls out a folder. He looks at the papers, and then accidentally drops them. While scooting around for the papers, which have blown around, he goes through a semi-transparent wall and becomes a man sitting in front of a computer terminal, smiling gently to himself.

Then suddenly, a gangster — you can tell from his stereotyped dress and look — comes in with a blank CD. The gangster pulls a gun and forces the man at the computer terminal to copy data to the CD. As he leaves, he speaks:

Don't tell anyone you made the copy. Remember, this CD will tell us the address of your family and friends. If you talk about this, we will take revenge. No one will know that you made a copy.

Subtitle and/or voice over:

This was an armed robbery — and as the robber pointed out, with a little skill, no one will learn about the copy since nothing vanishes.

Besides robbery or burglary, other traditional ways to steal are bribery, blackmail, bamboozlement, and making use of someone's belief.

The 'old five-some': burglary, bribery, blackmail, bamboozlement, and belief. These are dangers both to old fortresses and to new data repositories.

Think of all your and all others' information in one data base — or in several interconnected data bases. To be useful, tens of thousands of local police, customs' agents, state police, medical aids, and others must have convenient access. Are you confident that none of these people will ever be bribed, blackmailed, burgled, or bamboozled, or that no 'mole' will obtain a job, appear honest and helpful, and copy the information for an enemy?

And then, of course, there is accident . . .

Moving Image:

Eggs flying from basket. Fade out.

[It goes without saying that with well defended valuables, the programmers never work with the system or systems that hold the data, the data administrators check on each other, and the users can never access more than a few records each day. Moreover, no organization will do as the California government did in 2004, and transfer records to an outside entity — after the state did, up to 1.4 million records were copied. The exact number is not known. The records copied provide enough information to enable crooks to 'steal identities'.

[In a world focused on security, only an 'adversary' military will have the reason and can afford the cost — perhaps in the hundred of millions of dollars — required to fund a data theft. It will be difficult. Inexpensive data theft, such as that in California, becomes less and less likely. When computers that contained medical information on more than a million United States soldiers were stolen in 2002, all presumed that thieves had taken them only to sell the hardware. None thought that crooks knew enough to sell the data to an adversary for vastly more than they could sell the stolen machinery. At that time, the presumption was correct, as far as we know.]

1

1

Subtitle and/or voice over:

> If you want your country well defended, and if you want to feel secure personally, then you must insist that neither a government nor a private company nor any other organization collect your information in one place, or permit information in several places be accessed by an 'interconnect' method or group of methods.

> Traditionally, governments have thought to increase their and their citizen's security by centralizing information. Police and other agencies then access and use this information. Unfortunately, this is the wrong approach. The more successful a government or private business is at collecting information and providing access to it, the more that access is worth to a crook or spy.
>
> A central information repository – or a distributed one that appears 'central' only because of electronic linking – is like a single, central fortress; once infiltrated, corrupted, or captured, the fortress falls. When a fortress contains information, capture may mean 'copy'; there may be no visible indication that anything is wrong. The legitimate users may carry on happily and blindly.
>
> Not only do defenses keep out enemies, they hinder friends. Segmentation is expensive. Segmentation raises the cost of information inputs to those who try to help.

Clearly governments can and have kept some secrets well, but such endeavors are expensive. Moreover, they become more expensive as they become more useful to the 'good guys'.

(See *Software Freedom: An Introduction*
`http://www.teak.cc/softfree/software-freedom.html#Software%20Dangers`

1

1

Words Only

This chapter is about words, which are one kind of influence — and about the importance of metaphor. Metaphor is more than a figure of speech; it provides ways to think.

First, consider Aristotle's traditional three branches of oratory. These reflect the kinds of misrepresentation we must expect in most oratory.

Aristotle's three branches list the kinds of oratory that we should hear in a traditional society that does not find new things about the world.

Also consider a kind of understanding that seems far removed from political persuasion: mathematics. To understand a mathematical expression requires an understanding of metaphor. Otherwise, you may reach a 'proof without understanding' (and also find mathematics incomprehensible and boring.)

Political persuasion also requires an understanding of the role of metaphor.

Next consider transcultural persuasion. This form of persuasion is another, non-traditional, non-Aristotelian branch of oratory, the "determinative" branch. It consists of three methods that are robust. These give us hints towards truth, which helps societies avoid disastrous decisions (see "Disastrous Decisions", page 57).

Moreover, these hints will be perceived in no more than four general ways. These ways have similar mathematical characteristics to the major modes of human social structure. As I said earlier (see "Pollution Market", page 27), corruption determines the degree to which a government can control the social structure it uses to regulate pollution.

In all situations, we must judge the quality of our evidence. While I am not going to suggest that humans change, in order to provide a different way of thinking about the topic, I am going to discuss a method for computers that humans might use.

This method, along with two others should be taught well in school.

Aristotle's Three Traditional Branches of Oratory

In "a Bigger Danger If Natural", page 59, I spoke of Senator Inhofe as exemplifying a 'cannot do' spirit. But that may be wrong.

It may be that Senator Inhofe thinks as people did centuries past, as Aristotle wrote, rather than as they do now: it is not that he figures we 'cannot do' a difficult task, but that the whole concept of climate change is not part of his understanding of the world.

Aristotle defined three branches of oratory (see Aristotle in "Rhetoric" volume 1 chapter 3 (`http://www.perseus.tufts.edu/hopper/text.jsp?doc=Perseus:text:1999.01.0060:book=1:chapter=3`) and The For-

est of Rhetoric — branches of oratory (`http://rhetoric.byu.edu/Branches%20of%20Oratory/Branches%20of%20Oratory.htm`)):

1. **Judicial** oratory (or "forensic" oratory; oriented to what the accused was said to have done; the past);
2. **Deliberative** oratory (or "legislative" oratory; oriented to what might be done; the future); and,
3. **Epideictic** oratory ("ceremonial" or "demonstrative" oratory; oriented to the present; nowadays, this includes the kind of persuasion used in markets when price differences fail to signal significance).

Aristotle did not include "determinative" oratory, which is science. It had not yet been discovered. The "determinative" branch is timeless.

Perhaps Senator Inhofe is Aristotelian and centuries behind the present.

Fundamentally, the determinative branch of oratory, science, is a way to persuade that one judgement is more suggestive than another. As I say elsewhere (see "What is Science?", page 70), mathematics provides one method, about which Aristotle knew; similar observation provides another, at which Aristotle tried, but failed to succeed as well as we could wish; and experiment provides a third, which Aristotle did infrequently, if at all.

Suppose that Senator Inhofe is Aristotelian. In this case, it is doubtful that he sees a misrepresentation of others' determinative works as a misapplication of talent and a moral failing. Rather, it is more likely that he sees this as an application of 'deliberative' oratory.

By Aristotle's reckoning, the consequences of an action taken as the result of a legislative or deliberative debate are not mysterious. They involve only what is known. The consequences may turn out badly, but they can be foreseen. The debates are over 'the worthy, the unworthy, the advantageous, or the disadvantageous'.

However, Aristotle is wrong. Not all debates are founded only in persuading people regarding what is known. Some debates' consequences depend on discovering about the universe, on gaining suggestive evidence regarding what is unknown.

For example, among other issues, whether or not Americans are harmed by Chinese coal burning depends on the degree to which the current climate is changing, the degree to which that change, if any, is caused by human action, the degree to which aerosols mitigate, if at all, a change caused by extra carbon dioxide, and the probability that the Chinese might act against aerosol air pollution.

Understanding Without Proof

Mathematics has long confused people. On the one hand, its theorems persuade. On the other, no one understood why humans could be convinced unless theorems somehow had the same reality as sticks and stones. But

mathematical expressions do not look like sticks and stones ... Until recently, no one thought that metaphors might serve to extend very basic understandings.

Euler's famous equation $e^{i\pi} + 1 = 0$ relates the five most important numbers in mathematics:

- **e**, which tells you how quickly a quantity grows when its growth depends on how much has grown before;
- **i**, the square root of minus one;
- **pi**, the ratio of the circumference of a circle to its diameter;
- **one**, the amount of a single instance;
- **zero**, which is not there.

```
[ If you cannot see the equation above,
here are two ways of writing it in plain text:

      e^(i pi) + 1 = 0
and
       i pi
      e     + 1 = 0

Euler, by the way, is pronounced 'Oiler' in English. ]
```

After proving this formula in a lecture, the mathematician Benjamin Peirce said

> *Gentlemen, that is surely true, it is absolutely paradoxical; we cannot understand it, and we don't know what it means. But we have proved it, and therefore we know it must be the truth.*
>
> (Quotation from E. Kasner and J. Newman,
> *Mathematicas and the Imagination*,
> New York 1940
> See `http://www-gap.dcs.st-and.ac.uk/~history/Quotations/Peirce_Benjamin.html`.)

Peirce was unable to express to others the meanings which underlie mathematics, although there is no doubt that he worked with them. He was able to prove Euler's equation to his own satisfaction, but his remark demonstrates 'proof without understanding'.

At least Peirce could prove the relationship. I was worse: when I first heard of Euler's equation I could neither prove it nor understand it.

Fortunately, understanding is now easier.

Recently, George Lakoff and Rafael E. Nez[1] wrote that a mathematical idea is based on a 'conceptual metaphor', an

> *. . . inference-preserving cross-domain mapping . . .*
>
> *. . . a cognitive mechanism for allowing us to reason about one kind of thing as if it were another.*

The authors argue that mathematics consists of metaphor piled on metaphor, blended and transformed, so people often do not realize the basis of it all.

Lakoff and Nez provide evidence that infants can see the sizes of groups of up to four objects and recognize subtraction and addition prior to the development of language. They contend that arithmetic comes from an inference-preserving extension of this ability to larger numbers.

Moreover, they argue that there are actually four 'grounding' metaphors (metaphors based on experiences many of us had as children); these are:

- adding and taking away objects from a collection (playing with pebbles);
- construction of a larger whole from smaller objects (playing with blocks);
- measuring the width or height of something (by stretching our hands to the ends of the object or standing up to see how high it is);
- moving from one place to another (by crawling or walking).

These experiences provide us with four metaphors that work with arithmetic: four inference-preserving cross-domain mapping mechanisms that work consistently with each other and the world.

Measuring provides us with zero and moving backwards provides us with negative numbers. By blending these metaphors, and insisting on consistency, we get zero and negative numbers for collections, too. And then by adding new metaphors based on existing arithmetic metaphors onto existing ones, we get the 'empty set' and set theory . . .

To quote Daniel J. Solove,

> *Metaphors do not just distort reality but compose it.*
> (`http://papers2.ssrn.com/paper.taf?ABSTRACT_ID=248300`.)

These ideas change the salience of my understanding. No longer do I think of a metaphor as 'merely' a figure of speech or as an aid to thinking. Instead, I have come to realize that much thought — and all abstract thought — is based on metaphors.

Look at Euler's equation again, $e^{i\pi} + 1 = 0$

[1] *Where Mathematics Comes From:*
How the Embodied Mind Brings Mathematics into Being,
George Lakoff and Rafael E. Nez,
2000, Basic Books, page 6
ISBN 0-465-03770-4

The hard part is the first: the number **e** raised to a power with the product of the square root of minus one and **pi**. What is going on here?

Lakoff and Nez argue that the expression makes sense if, but only if, we understand that mathematics consists of the metaphorical extension of familiar notions into unfamiliar areas.

First, it is straightforward to think of multiplying the number **2** with itself three times: two times two times two. The answer is eight.

The next step is to imagine multiplying two with itself some fractional amount, such as two and a half times. This is hard, since ordinary multiplication can only operate as an integral whole. However, we do know that two times two is four, and that two times two times two is eight. So if we were able to multiple two with itself 2.5 times, the result would be somewhere between four and eight. (It is approximately 5.66.) Some centuries ago, mathematicians figured out how to calculate such results. The procedures are not the same as those you follow to multiply two times two, but the idea is consistent with doing that.

It is easy to imagine multiplying a fractional number with itself: for example, 2.5 times 2.5, which yields 6.25. (Of course to understand 2.5, we need to understand fractions. Perhaps the base for that understanding comes from crawling part way to the cookie jar as a baby.)

The next step is a combination of the previous two: multiplying a fractional number with itself a fractional number of times. (Two and a half multiplied by itself two and a half times is a bit more than 9.88.)

The number **e** is a bit more than 2.71828. It is the number you find when you figure out a value that depends on its previous values. For example, air pressure on the surface of the earth depends on the air above the surface. That bit of air above the surface has a pressure, too, which depends on the air above it. The numbers of plants or animals in an ecology depend on the same number, with the additional constraints that the ecosystem can provide only so much food, and others will infect or eat them.

Both **e** and **pi** are fractions. You can multiply **e** by itself **pi** times — this is **e** raised to the **pi** power. The result is a little more than 23.14.

The square root of minus one is not a regular number like 2 or 3.14159; you cannot place it somewhere on the ancient 'number line'; you cannot crawl to it going forwards or backwards. That is why, historically, it was called 'imaginary'. It does not fit the ancient way of thinking about numbers. However, **i** does perfectly well when we think of it as a 'lateral' number, as Gauss suggested. If you are crawling or walking up the ancient number line, you need to turn. Perhaps it is even better to think of **i** as suggesting a quarter turn, rotating one-quarter of the way around a circle.

pi, you will remember, is the ratio of the circumference of a circle to its diameter; this is another way of saying that it is the ratio of the circumference of a circle to twice its radius, since a radius is one half a diameter.

A rotation is a complete turn. By a consistent metaphor, you can think of this as crawling or walking around a circle. This means moving a distance that is twice times **pi** times the radius. If the radius is one, then a complete turn means going twice **pi**.

The distance for a half turn is one **pi**.

The number **i** is an indicator of a rotation, along a radius of one unit.

Originally, we insisted that **e** multiplied by itself some number of times be a result on the ancient, straight number line. But we can also talk about a situation in which we turn. Metaphorically, **e** can be extended to this notion, and extended consistently.

This is how **i** fits. It tells us to go out a unit and then crawl or walk around the circle for which that unit is the radius. The distance we are going to travel is **pi**.

And where do we end up? This is the beauty of the equation. We end up at the location of minus one on the ancient 'number line'. When we add one to that number, the result is zero.

The key to understanding — not the key to mathematical proof, which is different — is that mathematics comes from consistently extending fundamental experience, such as crawling. Each extension is consistent with what went before, but a little different.

Mathematics provides one way to persuade others; it succeeds because others duplicate your reasoning; it fails when others do not understand the metaphors you use.

Mathematics is difficult because most people do not see the metaphors that give meaning. So all they learn is proof, which is boring when meaningless.

[Brad DeLong inspired me by quoting Benjamin Peirce.
(`http://www.j-bradford-delong.net/movable_type/2004_archives/000734.html`)]

What is Science?

Fundamentally, science is a form of transcultural communication. It is a way of persuading someone that one judgement is more suggestive than another (see "Certainty Factors", page 80). Mathematics provides one method of communication; similar observation another; and experiment a third.

Communication is important because ultimately governance depends on persuasion (see "Means", page 96).

Instead of trying to persuade another by appealing to common cultural understandings, or by appealing to a widely accepted authority, a scientific communication strives to generate an internal experience of some sort within the listener.

This is strong, since an internal experience is undeniable.

The advantage of science as a method of persuasion is that it is robust. If you have a good reputation, many will simply accept your assertion because of your authority. Indeed, adults almost always depend on others when forming their opinions.

However, when people do not wish to depend on others, when they distrust authorities, then, for communications to succeed, they must follow your reasoning, or duplicate your observation, or repeat your experiment.

Some may be open minded; modern physicists often are. As one correspondent said,

> *Shelly Glashow was almost laughed off the stage for proposing Electroweak at a [physics] conference. A year later, almost everyone agreed that he was right. Within a few years it was called "The Standard Model."*

But sometimes the other person thinks you are wrong and will not listen. The other person may be an enemy. Communications will fail.

An enemy will never accept your authority. He or she will not accept your world view. As one commentator implied, for many authorities, statements are a matter of 'public relations' and have nothing to do with truth. Nothing that you can say will come across. Your enemy has various reasons to think you are wrong and will not change.

Such people are unreachable, whether with scientific or non-scientific forms of communication. But their students are different. Students and other young people often 'cause trouble' — they may not listen to their 'betters'. They are the ones you may reach. (This is not invariable. Some cultures are so strong that very few within them change. But it is a tendency.)

One of your enemy's students may well think though the same problems as you, or make similar observations, or, most effectively for your attempt at changing minds, conduct experiments that confirm your results.

A student tends to follow his or her teacher, but if you come up with a good way to reason, good observations, or a good set of experiments which the student can replicate or which people the student respects can replicate, then the student may come to believe you.

Because scientific communication enables one person to recreate another's experience, it is the best form of transcultural communication yet known.

Let me be more specific: for robust communications, scientists use three methods to generate internal experience in another listener.

- **I learn from internal experience.**
  This is to say, the listener **replicates the reasoning**. Mathematical beliefs come from this, because people reason (see "Understanding Without Proof", page 66).

  At the same time, internal experience includes dreams, visions, and personal revelation. Many religious beliefs are confirmed by revelation.

Mathematics is transcultural because people from different cultures follow the same process of reasoning and come to the same conclusions. But people from different cultures who each have revelations often interpret them differently.

- **I observe.**
  This is to say, the listener **replicates the observations**

  Astronomical observations and old-fashioned biology are examples. The key is that the person himself or herself makes the observations, and understands how they are made. Otherwise, the 'observation' is simply a report by another: another case of *I hear*.

  In addition, the person must also reason that there are no better alternative interpretations of the observations.

- **I do.**
  This is to say, the listener **replicates the experiment**.

  Again, a key is that the person do the experiment and not let another do it.

As I said, this method of communication fails when directed towards someone who will not listen, reason, or experiment. But in most societies, some will listen.

We can list other ways of learning. The two most common are:

- **I know culturally.**
  For many people, this is the background of all their beliefs.
- **I hear.**
  This is the dominant mode for establishing a new belief, since it means going by authority. It includes hearsay. (Knowing culturally comes from the same mode, but people are so young when they learn culturally that they think of it as different from accepting authorities as a grown up.)

  In rhetoric, the traditional sources for **I hear** include citing authorities, witnesses, maxims or proverbs, rumors, oaths, documents, law, precedent, and the supernatural.

Neither **I know culturally** nor **I hear** succeed well across cultures.

The three methods that generate internal experience in another listener are successful because the experience is undeniable. Consider a numinous religious experience.

As Roy Rappaport[2] said

> *A numinous experience compounds the emotions of love, fear, dependence, fascination, unworthiness, majesty and connection. It*

[2] *Ecology, Meaning and Religion*,
Roy A. Rappaport,
1979, North Atlantic Books, p. 217
ISBN 0-913028-54-1 paperback

does not have any particular references, but 'is powerful, indescribable, and utterly convincing.'

Traditionally, numinous experiences were interpreted in terms of a culture's religion. Communications about them failed to cross cultures.

However, a person can replicate another's reasoning, seeing, or experiment and this process can cross cultures (or enough of them). Since the reasoning, observing, or experimenting are done by the person, not by someone else reporting to the person, these experiences are as utterly convincing as a numinous religious experience.

Note how vital it is that the person who is reasoning, observing, or doing follow in your footsteps. Only by doing this can anyone be sure of replicating another's experience, and thereby checking it.

As a practical matter, most people accept new beliefs because they come from a trusted authority. Few have the resources, interests, or time to reason, observe, or experiment. For most people, existing knowledge and technology are simply another gift of their culture. Knowledge and technology are accepted, like other beliefs.

In addition to being a form of transcultural communication, reasoning, observing, and doing are, as I said, a way of persuading someone that one judgement is more suggestive than another (see "Certainty Factors", page 80). Moreover, the more suggestive notion is also more likely to be a good hint towards what is true in the external world. This is essential, since otherwise, countries and societies can make disastrous decisions (see "Disastrous Decisions", page 57).

This goes beyond the view of either the 'modernists' or the 'post-modernists', two important contemporary philosophical views.

Post-modernists argue that there is no such thing as 'reality'. After all, you cannot depend on a sense of reality that derives from authority. **I hear** is no good, even if it is dominant.

Also, the post-modernists point out, correctly, that you cannot depend on an internal experience whose interpretation comes from only one culture, since that culture's understanding of the world may be wrong.

But the modernists are right is saying there is some kind of external reality. You cannot live in a dreamworld forever. Eventually, debts must be paid, one way or the other.

Neither the modernists nor the post-modernists have taken the next step, which is that indeed truth is a social construct, as the post-modernists say, but that it must match 'something out there' to a degree, as the modernists say.

As a practical matter, you can only develop a truth — never an absolute truth, but a strong hint towards a truth — through a mechanism whereby people in different cultures check on the internal experiences of others.

Otherwise, you find your medicine is based on blood letting. This was a false belief in medicine two hundred years ago that killed a good number of people. (But it did not kill so many that it wiped out societies.)

Guttman Scales and the Structures of Social Life

For centuries, humans knew nothing about elephants infra-sonic communications. People could not hear them. Only in the past generation have zoologists gained new 'ears'. However, humans will translate the output of these technologically extended ears into just four forms of perception; and these forms of perception parallel the major modes of human social structure.

In 1944, Louis Guttman found that people perceive in such a way that all their forms of measurement belong to one of four types of scale: categorical, ordinal, interval, or ratio. In fact, forms of measurement can belong to more than those four scales, but people conflate them into those four.

More recently, Alan Page Fiske[3] argued that all social life is composed of patterns of interaction that are based on the same four types of mathematical structure as the four scales.

Thus, many early Marxists hoped to create a society that was based only on the 'included/excluded' criteria of a categorical or nominal scale. The hope was that people in a group would give "each according to his ability" and receive "each according to his needs.". In practice, this hope proved impossible. Accordingly, the Soviet Union created an ordinal "state capitalism" in which the government had monopolistic power.

In a market economy, one kind of decision is made predominately according to price, which is a ratio scale. However, when one or a small group of economic organization gains power, the type of scale shifts to ordinal.

This is often exacerbated by technological change in which high initial/low incremental cost activities become profitable, like steel making, petroleum extraction, flour milling, auto making, and television, to consider five older activities. Each of these endeavors had a high initial cost. In such a situation, oligopolistic or monopolistic economics makes most sense to those who control funding, such as investment bankers.

For example, it is less expensive and less complicated to fund a single group making radio shows, which are broadcast over a large territory, and also ensure that the government accepts the notion, than it is to fund multiple groups making multiple radio shows that are broadcast over local areas. For the latter, it is also necessary to create an organization that incorporates and receives payments from all those otherwise independent broadcasters to make sure the government accepts this notion.

---

[3] *Structures of Social Life: The Four Elementary Forms of Human Relations*,
Alan Page Fiske,
1991, Free Press,
ISBN 0029103452

In electoral politics, decisions are supposed to be made on the premise that each person has one vote. This indicates an 'interval scale'. It is illegal to sell your vote. (Selling your vote indicates a 'ratio scale'.) However, gerrymandering causes voters to lose power, which then attaches itself to those who are rich in time, the dedicated, or rich in other resources, the moneyed. (Hierarchical power indicates an 'ordinal scale'. Generally, selling-a-vote is to an organization that is moneyed, so that kind of corruption also indicates, albeit indirectly, an 'ordinal scale'.)

A religion may start with an 'included/excluded' criterion — are you a Believer? — but with metaphors such as 'flock' in addition becomes ordered. (It adds 'ordinal' to 'categorical'.)

If a religious organization specifies how long you will spend in Purgatory according the numbers of your good and bad deeds, that organization makes use of an interval scale. Another religious organization may use wealth, which is measured on a ratio scale, as a proxy for good and bad deeds.

In this case, the presumption is that the rich go to heaven and the poor do not. As a practical matter, while some look on 'unearned wealth' as bad and others suggest that 'earnings' should be good, for many it is not necessarily important how anyone came by his or her wealth, whether it was stolen or earned by doing good deeds.

In a country such as the U. S., you may see arguments that depend on the notion that oligopolies and monopolies are impossible or rare. This means that the economy must be competitive and free. This has a religious as well as political and economic implication.

In such an economy, individuals never have to purchase anything from any organization in particular. Consequently, those who make a fortune selling must have been doing good, because no one would have purchased 'bads'. Since oligopolies and monopolies are neither impossible nor rare, these arguments are weak. Externalities such as pollution do not exist, nor does thievery.

The four patterns of perception are not mere manifestations of a single culture, but are different primary mathematical structures. They are different axiomatically. They are transcultural.

They tell us the foundations of human thought: just as we understand a complex proof (see "Understanding Without Proof", page 66) by grasping the metaphors on which they are built (or often, fail to understand after failing to grasp the metaphors), similarly, we understand social structures only by working with childhood experience and with the metaphorical extensions of those experiences.

Put another way, the Guttman Scales are for thinking about numeric types, measurement, truth, and social structures.

Since they come from the simplest mathematical structures, they not only are transcultural, they are universal: intelligent, extra-terrestrial aliens are likely to base their thinking on them. Even if aliens hear differently

from us or use other weird senses, even if their language is as different from English or Chinese as an Australian aborigine language, we should be able to communicate.

It is easy to understand Guttman scales:

- You can say that one animal is a cat and another one is a dog. A cat is in a different category than a dog.
- Similarly, you can say that a captain in the Army is superior to a lieutenant but you cannot say by how much he is superior (and indeed, the 'how-muchness' is irrelevant). Military ranking is 'ordinal'; soldiers follow orders.
- You cannot meaningfully say that one Fahrenheit temperature is twice another. That is because the Fahrenheit scale has an arbitrary zero; it is an 'interval scale'. However, you can add ten Fahrenheit degrees to a Fahrenheit temperature.
- Finally, you can say that this stone weights twice as much as that stone, which indicates a ratio scale.

(In mathematicians' language, the categorical or nominal scale is based on an equivalence relation, an ordinal scale is based on a linear ordering, an interval scale is based on an ordered Abelian group, and a ratio is based on an Archimedean ordered field.)

Much progress in science comes from changing the type of scale used in a measurement. For many centuries, people said 'it is cold outside', in which cold is a category distinct from hot. Then people said 'it is colder today than yesterday'. This is an ordinal scale. After the invention of the thermometer, it because possible to say 'it is 10 Fahrenheit degrees colder today than yesterday', making use of an interval scale. Finally, after Kelvin and Boltzmann brought us understanding, an engineer could say 'the thermal energy content of this piece of iron is 0.6% less than it was yesterday', making use of a ratio scale.

As for truth: if you are using a categorical scale, you may say that a proposition belongs to the category of truthful propositions or the category of false propositions. The statement cannot be otherwise — the 'law of the excluded middle'.

When you use such a categorical scale, you are not saying how much truth there is in a proposition, only that it is true, not false. Traditional logic is based on there being only two categories, true and false; it makes the mathematics simpler. The various fuzzy logics are a formal attempt to add interval or ratio scales to logic.

With an ordinal scale, you can say that a first proposition is more credible than a second proposition, and that a second proposition is more credible than a third. In a court case, a jury may have to judge whether one person's testimony is more credible than another's, which means using an ordinal scale, so as eventually to place the defendant in one of the categories of 'guilty' or 'not guilty'.

Incidentally, a 'prioritizing' grid is a way to order a list of items. Compare two items each and choose the one you prefer. The item you preferred over all the others has the highest rank, and so on.

Prices provide numbers that can be used in a ratio scale. In so far as prices contain all the information necessary for choice, people choose items with a lower price. But when a price fails to contain all the salient information, other factors are added — perhaps you are bothered by the pollution or the rate of discount that a low price requires.

As I said, traditional logic presumes a statement is either true or false. The metaphor for this kind of logic comes from your early experience with a cup. Either your proposition is contained, like milk in a cup, and is true, or it is outside, spilled, and is false. The categories are inside, true, or outside, false. There is no third option.

An ordinal scale is like a hierarchy of naval ranks; a captain has a higher rank than an ensign. It is like Moh's scale for the hardness for minerals: you can say that topaz is harder than quartz but not how much harder.

When humans use McAllister's certainty factors (see "Certainty Factors", page 80), they impose an ordering: they say that some propositions are more suggestive than others.

With an interval scale, you can say that three apples are more than two. But you cannot compare apples to oranges with an interval scale. For that you need a ratio scale.

For millennia, apples and oranges have been compared by price: some form of money is used as a 'numeraire'. This has been customary and commonplace. 'Rates of interest' enable people to compare money flows over time.

But price is only one criterion that people employ to make judgments. Sometimes they use taste. Sometimes beauty. Sometimes goodness.

In computer programs, numbers may be used to indicate the quality of the evidence for a proposition (see "Certainty Factors", page 80). Even though the numbers appear to suggest a familiar ratio scale, as used in measuring weight or density, the computer program often limits operations on the numbers to a more restrictive set of axioms than that used by rational numbers.

Here is a table of **Guttman's scales**, which are **Fiske's patterns**:

Scale	**Structure Name** *Basic Empirical Operations*	**Permissible Statistics**	**Examples**
Categorical (or Nominal)	Equivalence relation *Determination of equality*	Number of cases, Mode, Contingency correlations	Assign model n Specify animal French, Chines
Ordinal	Linear ordering *Determination of greater or less*	Median, Percentile, Order correlation (type O)	Hardness of mi Quality of leath Pleasantness of Lieutenant, Co
Interval	Ordered Abelian group *Determination of the equality of intervals or differences*	Mean, Standard deviation, Order correlation (type I), Product-moment correlation	Temperature (Fahrenheit a Celsius) Calendar dates Alternated dim in the U. S.
Ratio	Archimedean ordered field *Determination of equality of ratios*	Geometric mean, Coefficient of variation, Decibel transformations	Length, weight density, resist Loudness scale Price

From:

- *Mathematics, Measurement, and Psychophysics*, by S. S. Stevens, in *Handbook of Experimental Psychology*, S. S. Stevens, Ed., 1951, Wiley, New York

and

- *Structures of Social Life: The Four Elementary Forms of Human Relations*, Alan Page Fiske, 1991, Free Press, ISBN 0029103452

See also:

- *A Basis for Scaling Qualitative Data*, by Louis Guttman, 1944, American Sociological Review 9:139-150

- *Introduction to Logic*,
  by Patrick Suppes,
  1957, Van Nostrand, , New York
- *Measurement and Man*,
  by S. S. Stevens,
  1958, Science 127:383-389
- *Measurement: the Theory of Numerical Assignments*,
  by Louis Narens and R. Duncan Luce,
  1986, Psychological Bulletin, Vol. 99 No. 2, p. 166-180
- *Structures of Social Life: The Four Elementary Forms of Human Relations*,
  by Alan Page Fiske,
  1991, Free Press,
  ISBN 0029103452

Groups and Rings

[The following segment is fairly technical and not necessary for the argument as a whole.]

To establish a categorical or nominal scale, you need a mechanism to determine whether an item is within or outside of the category. Is that drop of milk spilled, or not? This is done by determining whether two items are equal. If they are, if that drop is in the cup, then the second item is in the same category as the first item.

To establish an ordinal scale, you need to be able to determine whether one item is greater or less than another. Is that fellow wearing a naval uniform of a higher rank than that other fellow, wearing a somewhat similar uniform?

Both interval scales, such as Fahrenheit or Celsius temperature scales, and ratio scales, such as length or weight scales, form what mathematicians call 'groups'.

Mathematically, a *group* has four aspects:

- closure: all the elements that result from an operation are in the group;
  if you purchase an apple and then an orange, you still pay with one kind of money;
- associativity: `(a + b) + c = a + (b + c)` ;
  if you purchase an apple and an orange and then a grapefruit, you end up with the same three fruits that you would have if you had purchased an apple and then the orange and grapefruit;
- identity: there is an element such that `a + 0 = 0 + a = a` ;
  if you purchase an apple and nothing else, you buy only the apple; and
- inverse: for each element, `a`, there is an element `a'` such that when `+` is the operation,
  `a + a' = a' + a = 0` , then the inverse is the negative;
  if you put the apple back, you do not have it.

An Abelian group, like that of a Fahrenheit or Celsius scale, also has commutativity:

- commutative: for all `a` and `b`, `a + b = b + a` ;
  if you purchase the orange before the apple, you still have the same apple and orange that you would gain if you purchased the apple before the orange.

A *ring*, like that of a price or a weight, is a combination of two groups, one for each of two different kinds of operation. (In pricing and weighing, the two kinds of operation are addition and multiplication.)

A *ring* is an *Abelian group* like that above,
plus the operation of multiplication;
with the following laws for the second operation:

- closure: all resultant elements in group
  (When you add the weights of John and Mary, the result is a weight, not anything else, such as a temperature. This is so basic a notion, it is hard to see how critical it is.)
- associativity: `(a * b) * c = a * (b * c)`
  (When you add the weights of John and Mary, and then add the weight of Susan, the result is the same as adding the weights of Mary and Susan first, and then adding the weight of John. This also works if you multiply the amount of land you purchase by two, and then multiply the area again.)

Plus, a ring must have left and right distributive laws:

- left distributive: `a * (b + c) = a * b + a * c`
  (As you can see, an advantage of mathematical notion is that it is very concise. A disadvantage is that it can be so concise as to be confusing. Thus, the expression above says you end up paying the same regardless whether you pay all at once for two apples and three apples in one bag, or whether you pay for two apples and then for three apples.)
- right distributive: `(a + b) * c = a * c + b * c`

A ring with identity is a ring with an identity law for the second operation:

- identity: `a * 1 = 1 * a = a`

In addition, a ring is:

- commutative: for all `a` and `b`, `a + b = b + a`

Certainty Factors

A certainty factor expresses how accurate, truthful, or reliable you judge a statement. It is your judgement of the evidence.

People have always made judgements. Nowadays, people use computers to help them. Many current computer programs enable people to analyze

probabilities and 'what if' situations more readily. 'Certainty factors' go a step further; they enable computers to combine degrees of certainty to gain more confidence, but never to become completely sure.

Traditional logic is binary: either a proposition is true or it is false, either black or white. However, we live in a world of gray — or of even more colors. The advantage of binary logic is that it is relatively simple. The disadvantage is that it sometimes fails to match reality. (Students have trouble with traditional logic, but nonetheless it is simpler than more modern logics.)

Currently, computers use traditional logic internally. However, some computer programs, especially financial programs, try to model a more complex environment than one in which some facts are known to be true and others are known to be false. All financial programs, for example, handle interest rates, which are a way of combining a preference for the present with uncertainly about the future.

I am confident that over the next generation, we will see more computer programs come to rely on logics that are gray. There are two parts to such an action: one is the sensing part, which assigns a value to whatever is perceived. The second part is the method of combining multiple values.

'Certainty factors' provide a way to combine several sensed values.

In the mid 1980s, David McAllister developed a metric for 'certainty factors' for use in an 'expert system' (a type of computer program).

A certainty factor is used to express how accurate, truthful, or reliable you judge a predicate to be. It is your judgement of how good your evidence is. The issue is how to combine various judgements. (Or it is the 'judgement' of a computer and its sensors.)

Note that a certainty factor is neither a probability nor a truth value.

Consider the expression 'George is suffering from hypoxia'.

Based on warnings given to pilots, we would speak of there being 'strongly suggestive evidence' that George is suffering from hypoxia when he is flying in an unpressurized airplane at 4,000 meters (13,000 feet) and his judgement, memory, alertness, and coordination are off.

Note, we are not saying "there is an eighty percent chance that George suffers hypoxia"; that is a probability estimate. We are talking about our judgement of certainty. You may be able to generate statements of probability, such as: "80% of U. S. Air Force student pilots will fail to maintain altitude within 100 feet when they fly higher than . . . meters without supplementary oxygen, and this will indicate they suffer from hypoxia." But this is a different sort of statement than one involving certainty factors.

In this example of uncertainty I am taking the information that I was taught as a student pilot and creating from that a mechanism for diagnosing hypoxia. I don't know the probability that a person of my health and age will suffer hypoxia at 4,000 meters but I do know the symptoms, which, however, may be weak, or have other causes.

In McAllister's scheme, a certainty factor is a number from 0.0 to 1.0. A phrase such as 'suggestive evidence' is given a number such as 0.6; 'strongly suggestive evidence' is given a number such as 0.8. The person making the judgement uses the scale more or less as an ordinal scale in which one item trumps another. The numbers are used in a metric to permit a computer to make calculations.

McAllister's rules for combining certainty factors are such that you can add new evidence to existing evidence. If the evidence is positive, this increases your certainty, as you would expect. But you never become 100% certain.

Continuing our hypoxia example: George tells us that he feels wonderful. This is 'suggestive evidence' that George suffers from hypoxia. (Pilots are warned of this: "if you feel euphoric, consider hypoxia: you may be flying too high without oxygen, or suffering carbon monoxide poisoning from a broken heater." Of course, there are many good reasons to become euphoric when you fly; hypoxia is insidiously dangerous.)

McAllister defined the rule for adding two positive certainty factors like this:

```
CFcombine-add (CFa CFb) = CFa + CFb(1 - Cfa)
```

I.e., reduce the influence of the second certainty factor by the remaining uncertainty of the first, and add the result to the certainty of the first.

In our example, the altitude and loss of judgment are strongly suggestive evidence, with a certainty factor of 0.8; and euphoria is suggestive evidence, with a certainty factor of 0.6. The combined certainty factor is:

```
.92     =  .6 + .8(1 - .6)
```

(Incidentally, it does not matter which factor you start with first:

```
.8 + .6(1 - .8) = .6 + .8(1 - .6) = .92
```

Both sequences produce the same result.)

McAllister also has rules for adding two negative certainties, and for adding a positive and a negative certainty. A negative certainty is the degree to which you are certain a case is not so.

The rule for adding two negative certainties is simple. Treat the two factors as positive and negate the result:

```
CFcombine-add-both-neg (CFe CFf) = -(CFcombine (-CFe -CFf))
```

The rule for adding positive and negative certainty factors is more complex:

```
CFcombine-add-pos-neg (CFg CFh) =
    (CFg + CFh) / (1 - min{|CFg|,|CFn|})
```

Thus, if your certainty factor favoring an instance is 0.88 and your certainty factor against it is 0.90, the result is:

```
-.17     = (.88 + -.90) / (1 - min(.88, .90))

         =   -.02 / .12
```

I.e. take the difference, and then multiply that value by the reciprocal of the smallest certainty (treated always as a positive number) subtracted from the number one.

These three rules provide an interval scale for certainty factors.

You will note that you cannot say that a certainty factor of 0.8 is twice the certainty of 0.4; the rules of this metric only involve those of addition and subtraction that I have shown, no others.

An Exercise Using Certainty Factors

As I said earlier, a certainty factor expresses how accurate, truthful, or reliable you judge a statement. It is your judgement of the evidence (see "Certainty Factors", page 80).

It goes without saying that people have been making judgements from the beginning. The key to McAllister's certainty factor formulation is that it enables a computer to calculate a combination of certainty factors.

Certainty factors are a hybrid: for humans, they are an ordinal scale in which people specify an uncertainty that is more or less suggestive; for computers, they make up an interval scale consisting of numbers such as 0.6 and 0.4; and for calculation, they provide a ratio scale.

In McAllister's methodology, people express their judgements with phrases such as 'suggestive', 'strongly suggestive', or 'weakly suggestive' and computers use numbers.

When a mechanical sensing element operates, a human programmer attributes different certainty factors to different measurements. Thus, you can imagine a sensor that detects just a little carbon monoxide in a cockpit's air: the output would be labeled as 'slightly suggestive'.

Combining Certainty Factors

The key to David McAllister's method is that certainty factors can be expressed as numbers and combined by computer.

Here is a table of the relations:

strongly or highly suggestive	0.8
suggestive	0.6
weakly suggestive	0.4
slight hint	0.2

As a reminder, here again are the rules for combining certainty factors:

- To add two positive certainty factors, add the first to the second, the second having been reduced by an amount that depends on the size of the first:

```
CFcombine-add (CFa CFb) = CFa + CFb(1 - Cfa)
```

- To add two negative certainties, combine the two factors as if they were positive and negate the result:

```
CFcombine-add-both-neg (CFc CFd) = -(CFcombine (-CFc -CFd))
```

- To add positive and negative certainty factors, sum the two and divide the result with the number one less than whichever is the minimum of the absolute values of the factors:

```
CFcombine-add-pos-neg (CFe CFf) =
    (CFe + CFf) / (1 - min{|CFe|, |CFn|})
```

A Floor Vacuuming Robot: Machine-made Observations and Human Evaluation

Over time, more observations will be made by a machine. The observations can be classified into statements with associated certainty factors, like this:

0.8 certainty, the object on the floor looks elliptical;
0.4 certainty, it looks tarnished like an old silver coin;
0.5 certainty, its largest angular diameter
indicates that for its distance,
the object is the size of a U. S. dime.

Put another way, an electronic camera returns an image. The robot's computer separates various parts of the image, perhaps by detecting contiguous and sharp changes in brightness, and applies various tests to each part. One contiguous and sharp change in brightness constitutes a portion of an ellipse. Its color is more or less like that of tarnished silver, and its size fits that of a U. S. dime (and, incidentally, of a good many other coins).

Let us combine statements, or rather, let the computer combine statements, which means reducing the influence of the second certainty factor by the remaining uncertainty of the first and adding that result to the certainty of the first. (The mathematical expressions are in Emacs Lisp.)

```
Sum:

    0.8
    the certainty of the first:

with

    (* 0.4 (- 1 0.8))
    the second certainty factor reduced by
    the remaining uncertainty of the first

    (+ 0.8 (* 0.4 (- 1 0.8)))
        which is 0.88

And then combine that result with the third uncertainty factor

    (+ 0.88 (* 0.5 (- 1 0.88)))
        which is 0.94
```

There is a 'strongly suggestive' certainty that the object is an old silver U. S. dime.

(As you can see, this computer program tells us it is a silver U. S. dime, not an old silver coin of the same size from another country; this is a fault.)

Just to show that the order in which you combine certainty factors is irrelevant, I will combine the last two statements and then combine that result with the first:

```
Combine the last two certainty factors:
  (+ 0.4 (* 0.5 (- 1 0.4)))
    which is 0.7

Combine that result with the first:
  (+ 0.7 (* 0.8 (- 1 0.7)))
    which is 0.94
```

A floor vacuuming robot could use sensors that are programmed to translate noisy and poor quality observations into statements such as 'looks elliptical with weakly suggestive reliability', and then combine several such statements into results on which it can act.

In this case, the programming would lead the robot to decide (with a strong certainty factor of *0.94*) that the object it detected is an old silver coin that should be picked up rather than vacuumed up.

Yes, you could program the robot to make the same decisions using fuzzy logic and probabilities. My contention is that for this kind of action, humans will consider certainty factors more understandable than probabilities. It will be easier for humans to figure out what the robot will do.

An expert will not need the 'crutch' of certainty factors; the expert will understand fuzzy logic and probabilities. But the expert is not the key here. From the point of view of a company selling a floor vacuuming robot, most sales will be to the majority who purchase robots without bothering to check how many coins they vacuum.

The key is to persuade the latter, the majority of buyers, that the purchase will be safe and do its job. The people who persuade the majority will be a late portion of 'early adopters'. These people will not be experts. They will not harm their own cause by causing others to think 'it is good for them, but not for me'. Instead, if the task is not too time consuming, and fairly comprehensible, these 'early adopters' will investigate how the robot works, either by putting coins and the robot in the same room, or by reading the robot's rule set, or both. In this circumstance, certainty factors make for a simpler rule set than fuzzy logic or probability.

This is how an 'early adopter' will convince himself that the robot is not too stupid, and rather than vacuum the floor himself, he will let the robot do it. And his example will persuade others.

What Should Be Done?

So far, we have described 'what is'. In addition, we have reminded ourselves that people think about what 'cannot' be done, what will be 'wrongly' done, and what 'can' be done. We have considered ways to help decide "cannot do", "wrongly do", and "can do".

Decisions result from asking what should be done? Decisions are easy when the question is whether to pick up a tarnished, old silver coin. They are harder otherwise.

In a civilisation, there will be conflict over goals. I talk about some of these in the next section.

Then I talk about an issue that only a few at this time must undertake: creating trust-based institutions.

Then I talk about an example undertaking that should not be too controversial, tools for making judgements that could be taught in schools, which would help the next generation.

Next, an example undertaking that could be undertaken now.

Then, a more speculative, very useful undertaking that looks hard; but that we should consider.

In another section, I talk about the fundamental issues that a political group might consider: Opportunity, Compassion, and Justice

And in my final chapter, I talk of what you can do to help make decisions now, regardless of your situation.

Conflict over the Goals of a Civilization

On 2004 May 26, I went to a public hearing to provide moral support to an old friend, Amy, who sought a special permit to keep a rooster and chickens behind her house. In the hearing, a neighbor said that he did not mind the noise of two-stroke engines but disliked the sound of the cock crowing. The issues are clear:

- Should we accept the noises of animals like a rooster, or reject them?
- Should we accept the noises of trucks and two stroke engines, or reject them and seek quieter engines, such as those that combine fuel cells with electric motors?
- Should we treat old and edible farm animals, like chickens, as pets?

I have known Amy since she was born. Also, it turns out that I went to school with the uncle of her main opponent, her neighbor Peter. The town Planning Board held the hearing. As you might expect in a small town, I knew its head, who nearly married another friend of mine.

Amy had already kept these chickens for several years. When she started keeping them, she did not realize she would need a special permit. That is why the rooster, chickens, chicken house, and fenced yard were already all in

place. Amy grew up, as I did, in the next town over, where no such special permit is required. Both our families kept chickens when we were little.

Others speak of a clash between civilizations (`http://www.alamut.com/subj/economics/misc/clash.html`), but our towns in western New England are more like neighboring valleys in Afghanistan. One town regulates chickens; another does not. Towns are as different from each other as they can be, unless an outsider comes upon them. What we see here is not a clash between civilizations but a clash within a civilization.

When I came to the hearing, I was not too sure why Peter would so strongly oppose Amy. I like chickens. I like listening to a rooster crow in the morning. I like fresh eggs. I like the taste of chickens that eat worms and ticks, even if they are old. (One reason Amy first kept chickens is that they eat the ticks that gave her Lime Disease.)

Amy will not eat her chickens any more than she would eat a dog. Just as dogs are not a part of American cuisine, her chickens are not part of Amy's.

The conflict revolved around noise. The rooster's crow woke up the neighbor. Moreover, he noticed it during the day. To cut the sound, Amy built a wall of hay bales around the chicken coup and insulated it, too. That was for the night. During the day, the chickens and rooster were outside. When I visited, the cock crowed. but I barely noticed. Indeed, I would not have noticed except that the quarrel alerted me.

On the other hand, I notice and am bothered when distant trucks churn their gears. I do not like the sound of two-stroke engines, whether on lawn mowers or on the vehicles that kids drive. I dislike amplified music from passing cars.

At the hearing someone suggested using a electronic meter to measure the sound level at 4:30 in the morning at the neighbor's place. To be heard, a cock's crow would have had to come through the sound proofing and the hay wall around the chicken coup and the distance. I am sure that had this been done, an audiometer would have measured the cock's crow at or below the level of the ambient sound. It would have been quieter than passing trucks.

This measurement would have, I suspect, favored Amy. But I do not think such a measurement reflects the issue. The human mind handles sound wonderfully. In this case, I can believe that Peter and his supporters hear and notice the rooster's crow, even when it is faint. Their minds extract the information from the background and focus on it. It is like my hearing a truck's clashing gears.

The conflict is, I think, over what should constitute a civilization:

- Should we accept the noises of animals like a rooster, or reject them?
- Should we accept the noises of trucks and two stroke engines, or reject them?

Do we support our current technology or do we support an older one? Or do we support a yet newer possibility?

- Do we treat old and edible farm animals as pets? My friend thinks of her chickens and rooster as pets. Nowadays, many people keep dogs and cats as pets rather than as working animals.

These are three alternatives. I myself do not think we should support our current technology; I think of it as a way-station to a better future. As far as I am concerned, the noise of trucks and two stroke engines is what an economist would call a 'bad', a polluting side effect of the 'good' that people want. I would not be so bothered by quieter engines, such as those that combine fuel cells with electric motors.

As for one way of accepting the first choice, going backwards: should we encourage a return to older technology? I am against that. It was inefficient. It was cruel.

Indeed, as far as I can see, one bad side effect of farming was political. Thousands of years ago, when people learned to herd animals, they learned to treat them as inferior, as entities to be herded. They learned to become shepherds. Rulers then extended the process of herding sheep to the metaphor of herding people. You may have heard the hymnal phrase 'the shepherd guards his flock at night'. Lay people are supposed to hear that and think of themselves metaphorically as a flock of sheep.

Interestingly, in languages such as English, the words 'governor' and 'government' come from the ancient Greek word for the steersman of a ship. I have heard it said, but I do not know how true this claim is, that in Arabic a common word for governor comes from the same root as 'horse tamer'. When the 'ship of state' sinks, not only do its crew and passengers drown, so does the captain. They are all on the same boat together. But when a horse tamer has trouble with a horse, he whips it. (Or did in the old days. It turns out that better results come from rewarding good behavior than from punishing bad. But for a herdsman, punishment is generally easier and cheaper than reward.)

The third alternative is to convert a cat, a dog, or a horse, or a chicken, into a pet. Rather than depend on the cat to protect your store of food, your dog to herd the sheep, your horse to pull the plow, and the chicken to provide eggs, each becomes a pet, kept for companionship. This is only possible when new technologies displaces the old.

It looked to me that the complaining neighbor supports our current technology. He does not protest noise from trucks or loudspeakers. He protests the rooster's crow. He may figure that he has got away from the technology of the past, but lacks hope for a more quiet technology. Hence an acceptance of contemporary pollutions, as being inescapable, and a protest of noise from the past.

My friend, on the other hand, reflects an oncoming future. In this future, rather than eat chicken, which I like, people make them pets.

She lost this conflict.

Trust

Trust is necessary because most people accept as true only statements from those whom they trust. Moreover, more people tend to disbelieve previously accepted authorities than disbelieved 40 or 80 years ago.

Since few have the time, the resources, or the interest to check statements' truths, most people listen to others. In effect, most people make use of organizations that certify trust.

A trustworthy group needs to provide two features: an operation that is believed sufficiently; and a way to ensure that what no one spoofs them.

The trust issue is well known. The modern twist is that the Internet offers new and less expensive mechanisms.

In the past, in the private business world, banks and insurance companies have always depended on trust. That is because they offer promises of future delivery, not anything that can be checked in the here and now. To show how solid they were, many nineteenth century banks built their buildings from stone. Similarly, an insurance company used the Rock of Gibraltar as a symbol.

As more people learn about modern techniques for advertising and marketing, and as more come to fear that those techniques are used by rulers, belief in what a government says goes down. Similarly, belief in the sayings of other 'respectable' authorities goes down.

In the past in the more lawful countries, middle class people tended to believe their government and other respectable authorities. (Others never did.)

Lack of belief is often justified. The problem is that without a truthful sense of reality, people cannot make good judgements. They will act – there is no way to avoid that – but their actions may not serve anyone well, except perhaps those manipulating them.

A trust-building mechanism exists for on-line information: append tags that tell you how others judge that information; and provide MD5 sums or the equivalent to ensure that you are not spoofed.

The basic act is straight forward: select the judges randomly and temporarily from an interested group. They will give their time voluntarily without pay.

For example, a Web site can ask randomly selected people who have logged in regularly to become temporary judges. (There is at least one Web site that I visit that does this; the 'higher quality' postings are less than one-tenth as frequent as the 'lower quality' postings. Moreover, the 'better' postings are excellent, probabilistically.)

Clearly, this method fails when a group of judges display a poor sense of reality. Suppose every judge thinks the world is flat? We need several different groups.

Moreover, we also need people from whom temporary judges gain their understandings: investigators. (See "What is Science?", page 70.)

A side effect is that an increase in trust overall tends to creates more political legitimacy, since political bodies dare not lie.

Also, a political entity requires a balance of 'freedom from' and 'freedom to'. Otherwise, rich alliances will have 'freedom to' and no one else will have 'freedom from' them. (See "The Petals of Cooperation", page 102.)

Soldier, Enemy Suspect, Criminal, Civilian

At the moment, we in this world lack a way for governments to decide whom to imprison for attacks against us and whom to release.

We need a new category, that of *enemy suspect*, who does not wear a uniform, but does fight.

Hitherto, Westerners and their governments have placed people who do them harm into one of three categories:

1. *civilians*, who are individuals to be tried in court;
2. *soldiers*, who are members of an enemy army who wear uniforms; and,
3. *enemy combatants* who do not wear uniforms, such as spies and saboteurs. These people are specifically excluded from the Geneva conventions.

The last grouping is a catchall for those not in the first two groups. For European countries over the past few centuries, enemy combatants who do not wear uniforms have been politically insignificant.

But the category of enemy combatants who do not wear uniforms is no longer insignificant.

We need to invent the criteria for including people in a another group, and procedures for handling them. The procedures must presume some are innocent and some are not. Let us classify these people as 'enemy suspects'.

As with captured enemy soldiers, the government would make it legal to imprison those who fall into the new classification. But at the same time, the new Resolution should specify how to determine when to release a prisoner.

The new classification has four categories:

1. *civilians*, who are individuals to be tried in court;
2. *soldiers*, who are members of an enemy army who wear uniforms;
3. *enemy suspects*, who do not wear uniforms; and,
4. *enemy combatants*, who do not wear uniforms, such as spies and saboteurs.

In the older, three part classification, civilians defined as criminals are released from prison at or before the end of their sentence. Captured soldiers who wear uniforms are released from their prisoner of war camps when a prisoner exchange is negotiated or a peace treaty signed.

But people in the current catchall group do not fit either category and may be imprisoned indefinitely. This should not be.

(The classification for spies and saboteurs should continue. If the people in the new category of 'enemy suspects' are removed from the old group, few will be left. Because so few will be involved, a sufficiently senior authority in government, such as a U. S. President, can set aside normal legal procedures and either pardon those who are convicted of acting illegally or else release them before any trial takes place. During the Cold War, much U. S./Soviet spying was handled this way.)

The dividing lines among various groups comes from the power of a government to **classify** actions. The kind of classification that occurs depends on how much knowledge can be obtained.

For an ordinary criminal action, a court is the social mechanism used to decide whether a defendant should be imprisoned. A court is, essentially, an institution for gaining knowledge and making judgements.

Ordinary people, guards, are given the legal authority to coerce those who are supposed to be in prison — and to kill them under certain circumstances.

However, in the case of a war, it is often not possible for a court to decide into which category a defendant belongs, since the person involved may not be local and may not be individually identified.

In this instance, another governmental mechanism is used, a declaration of war, or some equivalent. As a result of this action, all people who possess a certain fairly readily defined characteristic, such as citizenship in a particular nation, are defined as the 'enemy'. This is a crude classification mechanism, but it is the one used.

In a civil war, as in the United States between 1861 and 1865, or in a traditional war, such as World War II, a government will declare a state of rebellion or war. These actions will give it the legal authority to categorize people and to define the circumstances under which certain people may legally be restrained or killed.

Ordinary people, now called 'soldiers', are given the legal authority to coerce those who are categorized as the 'enemy' — indeed, to kill them under certain circumstances.

Note that when individuals can be identified, a court is becoming the preferred social mechanism. We see, for example, the trials in the Hague of those who have been arrested and accused of war crimes in the former Yugoslavia.

However, in many circumstances, it either is not possible to identify individuals or it is not possible to bring those identified to trial without a war.

The idea behind the 'laws of war' is to minimize harm to people crudely categorized as 'the enemy', but who are not doing much, or any, damage. For example, surrendered enemy should not be killed; 'collateral damage' should be minimized; and only military targets attacked.

The laws or 'guidelines' for war are based, at least in part, on what is considered reasonably possible.

If I remember rightly, during World War II the average bomb dropped by an American airplane missed its target by 1500 meters (5000 feet). Axis bombs also tended to miss. Hence, both sides decided that bombing cities and killing civilians was acceptable, because that was all that was possible.

Early hydrogen bombs would destroy such large areas that their use also implied that it was acceptable to kill many civilians. (Incidentally since those bombs were developed, the U. S. and the U. S. S. R. worked on making smaller and smaller nuclear weapons.)

Modern precision guided weapons are a new technology. They enable the United States military to destroy targets with much less 'collateral damage' than before. According to what I have read, only 800 or 900 out of every 1000 bombs dropped will miss their targets. (Some claim that as few as half or one-quarter miss, or even fewer. This rate compares to miss rates in the past of 990 out of 1000, or more.)

Regardless of the actual miss rate, fewer modern bombs will miss their targets. A consequence of this change in technology is that people are able to be more concerned about 'collateral damage' and dead civilians.

Military weakness means that a fighting group uses different techniques. For example, the Palestinians do not have a navy of their own. So they have not been able to blockade the Israeli port on the Gulf of Aqaba the way the Egyptians did.

Instead, the Palestinians have employed suicide bombers. (On a side note: the relevant Palestinians have said repeatedly that their long term goal is to destroy Israel. I see no reason to disbelieve them. At this time, since they have not been able to destroy Israel, their immediate goal must therefore be to prevent a peace that ends the war. After all, there are many who want peace.)

Aids for Judgement

In addition to certainty factors (see "Certainty Factors", page 80), children should be taught other aids for judgement.

This learning could be formal — hardly anyone will apply the concepts in everyday life, except as a time consuming effort to help make a few difficult judgements.

I have already mentioned the first aid: certainty factors.

The second aid is taught now, but poorly: probability.

This concept is centuries old. One of the first applications was to ship insurance; another, some three centuries old, was to fund government borrowing through annuities.

Over the years, insurers found that sinking and death were common and regular when applied to large numbers of ships or people, but unpredictable when applied to a specific ship or person.

As far as I know, the first insurers priced their offers to handle the past frequency of sinkings and death. They presumed the future would be similar to the past and choose a price that would make them a profit so long as the future repeated the past, more or less. They applied what they knew of past frequencies to future events.

The third aid is often confused with the second: it involves estimating the likelihood of a one-time-only event, such as whether the 'Titanic' will sink on its first voyage. Such estimates often use the same language as that used for insurance based on past frequencies. However, such likelihood estimates tend to depend on people's hopes and fears, even when they are analyzed into components, such as whether a captain might try to speed across the Atlantic in a fast, new ship.

Because of the similarity in language, and because both deal with the future, it is easy to confuse an estimate of the likelihood of a one-time-only event with an estimate of the likelihood of multiple future events that also have a past history.

Generally, the reasons for a one-time-only event can be divided into their components. These components are what might be considered 'other indicators'. After all, when judging the chance that a particular ship will sink on a particular voyage, general statistics are of little use.

Interestingly, these 'other indicators' can be judged as to their certainty. The 'other indicators' are not estimates of the future, but of the past — for example, how suggestive is the evidence that over his career, a particular captain sped through regions frequented by icebergs although he never came near any? The past is then applied to making a judgement about the future.

Even though certainty factors apply to judgements of the past, their use could well be to help suggest chances for the future. Put another way, an estimate of the likelihood of a one-time-only event may use the same language as insurance. However, it does not depend on a history of similar occurrences, but on evidence from other indicators.

Of course, a history of similar occurrences depends on how you judge that history. How good are your reports of ship sinkings? Nowadays, they will be fairly good — only occasionally do you hear of pirates stealing a ship and providing it with new papers and a new name. In centuries past, error was more likely.

As I write these words, people who are not sailors are beginning to accept the notion that occasional large waves will sink large ships. The large waves have been photographed by satellites; before that, their existence was dismissed as sailors' exaggeration.

But rather than use language such as *dismissed as sailors' exaggeration*, it is more illuminating to describe the change in the language of certainty

factors: from weakly suggestive to highly suggestive. With this language, no one denies that before the satellite discoveries, some people who were not sailors figured the sailors were telling the truth, or that some effort was made to investigate reports. The language also suggests a task for journalists and historians: to report how much was spent when ship owners, insurers, and government weather forecasters thought the evidence was 'weakly suggestive', and how much is spent when they think the evidence is 'strongly suggestive'?

A Larger Federation

Although a civilized world government looks unlikely, various contemporary nation states should join together to form a larger federation, or 'transnational sovereignty'. The new state must have revenue, have the ability to overrule a part of itself and, most importantly, be perceived by its citizens as legitimate. Strongly interconnected states, such as those in Europe, the United States, and Japan should consider this. They are, after all, already joined through organizations such as the World Trade Organization.

As far as I can see, a larger federation needs a three chamber legislature, not a one or two chamber legislature, as is now common. Power in the third chamber would be based on taxes that are truly paid, not on history or on population, the two current mechanisms. The reason for the third chamber is practical: a country such as such as the United States will join only if it feels safe. Otherwise, as with the UN, it will insist on a veto.

A Three Chamber Legislature

To propose a three chamber legislature is cynical. However, such a legislature has the advantage of convincing rich countries that they will not be overwhelmed by poor but populous countries or by a coalition of small countries.

If the U. S. joined such a new country, this proposal means that the U. S. would continue to have great power . . . but only so long as it continues richer than others and only so long as it pays its taxes.

Poor but hopeful countries could hope that they would gain power without war. Such countries fear a repetition of World War I, which many think occurred because Great Britain, France, and Russia were not willing to give peacefully some of their power to newcomer Germany.

Another chamber should be based on population, like the U. S. House of Representatives. This looks to me like a good way to help ensure justice.

A third chamber should be based on history. That is to say, it should be based on the principle of one (or two) votes per nation-state, as in the current UN. This is similar to the arrangement for a Senate made among differently sized states in the U. S. at the time of the framing of the U. S. Constitution. This attracts small countries who otherwise fear they maybe overwhelmed by the large.

(Some contemporary countries are very small. Consequently, the disproportion in power between large ones and small nation-states is even greater than it was in the 1780s between large and small U. S. states. To prevent this disproportion from wrecking the whole proposal, it may be necessary that some small countries federate with each other.)

As for the chamber in which power is based on taxes paid:

- Payments should be proportional to gross domestic product. Of course there will be arguments over how to measure 'gross domestic product'. Speaking technically, I think these arguments could well be useful.
- Similarly, member states should debate whether to increase third chamber representation if a member pays more than its due.

Veto Power

Another issue is called *veto power* in the UN and *states' rights* in the United States.

In the UN, certain states can veto mandatory Chapter VII resolutions. (Chapter VII resolutions are different from the more common, non-mandatory Chapter VI resolutions. The permanent members of the UN Security Council can also veto Chapter VI resolutions, but since they are voluntary, and give no nation a legal right to enforce them by war, they are less important. The U. S. based its legal right to invade Iraq on mandatory Chapter VII resolutions.)

Clearly, the United States will not join an organization in which it cannot veto actions that the government of the U. S. believes will damage the U. S..

Consequently, some sort of veto is needed. But the question is what sort? The United States itself was founded with vetoes of a sort. These *states' rights* hinder a Federal or 'super-state' government from taking actions that individual states dislike.

In the U. S. between 1790 and 1990, the constitutional provision of states' rights was moderately successful: that is to say, the U. S. suffered a civil war in the 1860s, and after 1950, states' rights eroded peacefully.

In contrast, western Europe lacked the mechanism. Between 1790 and 1990, the major countries of western Europe suffered the Napoleonic Wars, the Franco-Prussian War, World War I, and World War II.

Even though states' rights were not completely successful as a governance mechanism, they helped; over the 200 years from 1790 to 1990, the U. S. suffered fewer internal wars than western Europe.

Consequently, in a larger trans-national sovereignty, some measure of states' rights look necessary. I do not know what they should be.

(I suspect that the time period considered salient for this issue by U. S. decision makers will be two or three generations, even if their salient time periods for other decisions are only two or three months. Hence, this issue will be important.)

Incidentally, states' rights are similar to *individual rights*, such as the right to free speech. Individual rights hinder a government from taking actions that individuals dislike. Both the U. S. and the EU have codes of individual rights, as do other countries. (A separate issue is how well these codes are followed.)

Power within Three Chambers

A few details about a three chamber legislature:

- In a history-based chamber each country receives the same number of votes.
- In a population-based chamber, France receives less than one-fifth the number of votes of the United States. In turn, the U. S. receives about a quarter the number of votes that go to China.
- In a tax-based chamber, the U. S. receives perhaps six times the number of votes as France and perhaps ten times as many as China.

Goals

It will be hard to build agreement in a three chamber legislature. Much will not happen. Some argue that in government, this kind of 'grid lock' is no good. Others argue that you can ensure a more or less peaceful form of dispute resolution only by patiently persuading enough people and powers.

Peaceful dispute resolution is the first goal of government. That goes without saying. A second goal is justice. Currently, some international disputes are settled peacefully through the World Trade Organization and similar organizations. (At least they will be settled peacefully so long as the members figure they are better off losing gracefully than destroying the process.) But the WTO and its ilk not only lack military power, they lack the legitimacy provided by the mechanisms of a representative government. That is why the EU invented the European Parliament. While that legislature lacks much power, it is felt to be better than nothing.

The goals of a three chamber government would not only be to bring peaceful international dispute resolution into the realm of the domestic, but also to bring some degree of legitimacy to such action.

Means

For governmental success, Chet Richards (see `http://www.d-n-i.net/fcs/boyd_grand_strategy.htm`) adopts notions from the American strategist, John R. Boyd. Richards says that for success, a people need a

> *. . . grand ideal, overarching theme, or noble philosophy that represents a coherent paradigm within which individuals as well as societies can shape and adapt to unfolding circumstances . . .*

Richards goes on to say that the

> *. . . U.S. Constitution represents such a theme for [the United States]. The challenge of American grand strategy, therefore, is*

> *to uphold the ideals embodied in the Constitution, while showing that we respect the culture and achievements of our allies, the uncommitted, potential adversaries, and even the population of actual adversaries. . . .*

In addition, for a long lasting, secure, and large government, those who design its constitution must assume that its members will be intrinsically evil. Hence, the U. S. Constitution is a model, since its design was based on that premise,

Governments that depend on a 'benevolent despot', a 'benign emperor', or a 'good caliph' always fail, if not in the first generation of rulers, then in a subsequent generation (see "Order Law Justice Democracy", page 5).

As a great power, the United States should lead. It is in its own interests to do so. To gain victory in the long run, the U. S. must persuade people who live in foreign countries to condemn those in their countries who will act against the U. S. In order to do this, the U. S. must bring legitimate government to the whole world.

Unfortunately that may be impossible. One of its four major political traditions is currently dominant.

As I write this in 2004, the United States is following a strategy of intimidation. This fits what Walter Russell Mead calls the 'Jacksonian Tradition' in U. S. politics. (See `http://www.nationalinterest.org/issues/58/Mead.html`.)

According to Meade, three other traditions also move large numbers of Americans:

- *. . . the commercial realism of the Hamiltonians.*

  In the middle 1990s, members of the Clinton Administration feared that China would be dangerous to the U. S. so long as it remained 'middling rich'. But, they figured that when enough Chinese became prosperous, these people would act to prevent their government from endangering their comforts. Consequently, U. S. policy tried to encourage Chinese economic growth, so China would pass through its 'danger period' as quickly as possible.

  However, people in the 'Jacksonian Tradition' fear that a richer enemy is more dangerous.

- *. . . the crusading moralism of Wilsonian transcendentalists.*

  It goes without saying that many consider moralism impractical. They figure there will always be bad people in the world. They doubt that anyone can create institutions that will successfully deal with evil. They figure the Founders failed when they created the United States government.

- *. . . the supple pacifism of the principled but slippery Jeffersonians . . . .*

  To deal with the uncooperative, this requires 'actions less than war', such as the 1990s trade embargo against Iraq.

Many Americans doubt the practicality of polices that come from these other traditions. Those who favor intimidation argue that other actions fail.

Nonetheless, it is also true that intimidation fails in the long run. Even the Roman Empire fell. In the long run, power comes only from legitimacy, and legitimacy comes only from persuasion.

Thus, the United States must adopt a long term policy that others will accept, a policy involving **Opportunity, Compassion, and Justice** (see "Opportunity Compassion and Justice", page 98).

Opportunity, Compassion, and Justice

In the U. S. Presidential campaign of 1928, Herbert Hoover called for 'a chicken in every pot'. He staked his legitimacy on the promise of prosperity for all.

Certainly, over the past century, every country has sought to increase the prosperity of its people.

Is that goal going to continue, or will it be replaced by a new goal?

Philip Bobbitt[1] a man who combines legal and military ideas, argues that the next major political argument will be over the ways in which governments provide *opportunity*.

[1] *The Shield of Achilles: War, Peace, and the Course of History*,
Philip Bobbitt,
Random House, Knopf edition, 2002: ISBN 0-375-41292-1,
Random House, Anchor Books edition, 2003: ISBN 0-385-72138-2

In his long and hard to read book, Bobbit writes,

> *A great epochal war has just ended [the war lasted from 1914 to 1990]. The various competing systems of the contemporary nation-state (fascism, communism, parliamentarianism) that fought that war all took their legitimacy from the promise to better the material welfare of their citizens. The [newly emerging] market-state offers a different covenant: it will maximize the opportunity of its people. . . .*
>
> *A society of market-states . . . will be good at setting up markets. This facility could bring about an international system that rewards peaceful states and stimulates opportunity in education, productivity, investment, environmental protection, and public health by sharing the technologies that are crucial to advance in these areas. . . . Markets, on the other hand, are not very good at assuring political representation or giving equal voice to every group. . . .*

Put another way, Bobbitt argues that the 20th century saw conflicts among those who espoused different ways of promoting economic development, but that in the 21st century, we shall see conflicts among those who promote different paths towards equal opportunity.

Philip Bobbitt is Professor of Law, University of Texas at Austin; he has served as the director for Intelligence, senior director for Critical Infrastructure and senior director for Strategic Planning at the National Security Council, a man who combines legal and military ideas, argues that the next major political argument will be over the ways in which governments provide **opportunity**.

This means that some people will succeed materially more than others. At the same time, many will perceive themselves and be perceived by others as losers. These people will have made a mistake when they were 16, or an 'Act of God' will have befallen them, or they will fail at any job valued by a market society.

In turn, this means that **compassion** will become more important politically, since enough successful people will think 'there but for the grace of God go I'.

Moreover, since people dislike free riders, and since new times mean new issues which do not fit into traditional categories, visible **justice** will become more important.

Opportunity implies meritocracy. It means that enough individuals find a chance to do better, and that social status and material rewards come to those who best do what society seeks. The chance to do better is not determined, or at least, not ultimately determined, by religious upbringing or by accidents of birth considered extrinsic to a person, such as wealth or race.

When people receive rewards according to their degree of success, many see the system as a whole as just and legitimate.

It goes without saying that others value different sources of legitimacy and justice: people who become rich, for example, often want to pass on their positions to their children (see "Liberty and Resources", page 8). In so far as their children are less capable than others, the others' opportunities must be restricted. Otherwise, the rich children will lose. If others are not overtly restricted, then the rich children must be given advantages to compensate. Thus, the rich must provide better schools for their children, whether public or private, must provide better health care, and must provide language that justifies this (see "A Species is Not an Organism", page 51).

Both in the U. S. and elsewhere, many hope to succeed by doing 'more of what they should have done' rather than by doing 'more of what they should be doing'. The former is a known path, and clearly some followed it well. The latter requires deciding what 'should be done' and then doing it. Both deciding and doing are fraught with uncertainty.

However, over time, countries that make better military and economic use of their resources tend to overwhelm those that do not. This means a better use of all talents within a society, not just a few. Put another way, meritocracy wins wars.

So I expect that over the next generation or two, the backward looking responses of people in the U. S. and other countries will fail. (Whether the countries will also fail is another question.)

But there are different ways for a 'market state' to handle opportunity. Bobbitt identifies three:

- The **entrepreneurial**, in which a government acts to set people free to make their own decisions. The United States is an example.

- The **mercantile**, in which a government focuses on long term opportunities and social stability. Japan is an example.
- The **managerial**, in which a government attempts to achieve social equality. Germany is an example.

Each way handles justice differently. In the United States, and countries with the same goals, justice comes from a focus on individual rights, a belief that 'acts of God' are few, and that in any event, everyone has a 'second chance'. In the U. S., the 'second chance' belief is most vividly seen in those who are 'born again', an act which enables such people to disown the mistakes and accidents of their pasts.

In Japan and similar countries, justice comes from a focus on stability and a ban on chaos, even when rapid material changes take place.

In Germany and the like, justice comes from a focus on social equality and on caring for those who are eager to work but cannot. The premise is that by acting this way few unemployed will become so alienated as to become criminal or addicted to alcohol or other drugs, or become active in the kinds of political movement that have caused much suffering in the past.

I do not know how countries will respond to technological changes, but think there are strong suggestions for two themes.

Consider the following change: a sharp drop in the cost of information reduplication. Right now, unless effective law enforcement raises the price, a full computer operating system and office suite on a CD costs U. S.$1.50 - U. S.$2.50. The cost of the machine on which to run the CD is high, but a modern computer costs considerably less than any from 50 years ago. The cost of manufacturing a CD with data on it is much less than was the cost of duplicating, marketing, distributing, and selling 650 megabytes in 1954.

This is a technological change with social consequences. In particular, the only way to keep the price of data high is to enforce laws against inexpensive data transfers.

Effective law enforcement costs. In schools, for example, children must be taught that it is wrong to share non-rivalrous goods, like games or learning (see `http://www.teak.cc/softfree/software-freedom.html#Selfish%20by%20Law`). Programming students must be forbidden to study certain topics lest they become common knowledge. If this is not done, children will grow up to favor sharing; students will learn. Police actions to hinder sharing or knowledge will lose legitimacy and law enforcement will become more difficult.

The key political factor is whether people think that a shirt that only one person can wear at one time is different from software that two people can use at the same time, or whether they think the two are similar? The latter requires the metaphorical extension of the concept of property from a rival-

rous[2] good, such as a car which only one can drive at any one time, or chair in which only one can sit at any one time, to a non-rivalrous good, such as software, which because of the drop in copying costs, can be used by several people at once (see `http://www.teak.cc/softfree/software-freedom.html#Misleading%20Metaphors`).

As far as I can see, a country that focuses on social stability, a 'mercantile' state like Japan, will be less inclined to admit the turbulence that comes from lower prices. It will try artificially to keep prices high when technology permits them to drop.

On the contrary, a country that focuses on social equality, a 'managerial' state like Germany, will figure that its institutions will care for those hurt by price changes, and be more against governmentally enforced high prices.

The outcome in a country that focuses on 'rights', an 'entrepreneurial' state like the U. S., will depend on how the powers that be define legal 'rights'. They could come to think that people have a right to do what they want, so long as they do not prevent others from also acting; in this case, the right will be to copy information, and the price will be allowed to drop. Or they may come to think that individuals and companies have a right to keep information from others, and government policing will increase.

Opportunity, Compassion, and Justice make for a slogan. One or other political party should adopt it.

[2] The word 'rivalrous' means that your consumption *rivals* mine. Only one or the other, not both of us, can enjoy the consumption at the same time.

The Petals of Cooperation

The title of this chapter, *The Petals of Cooperation* is figurative. However, the flower offers us a natural political remedy, with three conditions, four criteria, and five qualities.

The stem and leaves define the three conditions that enable a just and sustainable society to succeed: *consent*, on which all else depends, *freedom*, and *law*, both of which nurture the whole.

Consent is the stem. It has veins and roots which supply it with nutrients. In less figurative language, consent implies both trust and legitimacy.

Trust requires not only a mechanism for learning truth about the world, as best anyone can, but also a mechanism for judging those who report truths.

Legitimacy not only reduces the cost of government, but enables complex government to succeed. Without legitimacy, a government can only rule by policing everything, which reduces freedom and prevents actions.

Freedom, which is here embedded in a nurturing and breathing leaf, means both 'freedom from' and 'freedom to'.

Law, too, is a nurturing and breathing leaf. The notion is that everyone benefits from law or should, not only the powerful. A reliable, quick, and honest legal system implies less corruption, more equality of opportunity, and more protection, both from hostile people and from dangers in the non-human environment.

The four blue petals are the criteria through which a person may begin to evaluate a political proposal: *protect*, *preserve*, *prepare*, and *provide*. In English, these are the 'four Ps of politics.' These criteria are very powerful.

The inner part defines the five qualities with which a citizen may further evaluate a social recipe: *reason*, *rigor*, *reality*, *responsibility*, and *honesty*.

The very center of the flower provides the vital details, which hurt or kill a society when they are wrong. The details are for a legitimate government to decide.

Because damage to the environment can impact vast regions, at times the whole planet, and because of lowered transport and communications costs and the consequent need for large scale and long distance dispute settlement, government must expand. Indeed, government has already expanded beyond the boundaries of the traditional nation states. In addition, it must become legitimate, which it has not.

For such legitimacy, I suggest a three chamber government with many restrictions on its powers, but none the less the ability to settle critical disputes, mostly by bargaining, but when necessary with police.

As I said earlier (see "Goals", page 96),

> *Peaceful dispute resolution is the first goal of government. . . . A second goal is justice. . . .*

Justice means the least undesirable use of force.

Freedom is a leaf. It is necessary because, as Douglass C. North said[1], in *. . . a world of uncertainty, no one knows the correct answer to the problems we confront . . . .* Moreover, freedom is preferred because people want it. Freedom means 'freedom to' undertake various actions, without however interfering with others' 'freedom from'.

An imbalance implies an injustice, and while peaceful dispute resolution is better, we may still have coercion without war, as in policing.

The balance is delicate: for example, the freedom of many individuals to act independently may well lead them as a whole to interfere with others' freedom from, even when none desire to hurt others. The classic example is car drivers who interfere with others' freedom from traffic jams.

Another kind of problem concerns the freedom of organizations to build installations that waste less than smaller installations, but still hurt others: for example, coal burning plants that generate electricity interfere with others' freedom from airborne poisons and freedom from dangerous climate change. Generally speaking one big coal burning installation is less damaging than many small coal burners, but nonetheless, it has a devastating impact

Law is other leaf. It is necessary to enable people and organizations to cooperate peacefully and to predict how others will behave.

To **protect** is a blue petal. The first necessity of any government is to protect people from immediate attack; a second immediate necessity is to protect people from government. This is why legitimacy is so important. Illegitimate governments must always hurt their people. (Illegitimate governments are sometimes accepted, because people figure it is better to be hurt by local crooks and thieves, 'devils they know', than by foreigners, who are 'devils they do not know'.)

Who should be protected? — only the members of a single clan or religion, or all humans in a small nation, or all humans on the planet, or all sapient beings? A 'categorical' or 'nominal' view changes depending on which populations are to be protected (see "Guttman Scales and the Structures of Social Life", page 74).

Against what should people be protected? Besides the obvious short term dangers of war, both symmetric and asymmetric, of crime, of tyrannical governments, and of other powerful organizations, what of the long term dangers to the environment, what of material poverty, what of spiritual poverty?

---

[1] *Institutions, Institutional Change, and Economic Performance*,
Douglass C. North,
1990, Cambridge University Press, p. 81
ISBN 0-521-39416-3 hardback
ISBN 0-521-39734-0 paperback

How to protect people? Currently, most people on this planet live in extralegal circumstances (see "Developing and Extralegal", page 17). That is to say, people protect themselves by depending on family, clan, friends, and crooks. This succeeds locally, but not globally. Rule by law is necessary.

To **preserve** is the second petal. A long term necessity of any government is to sustain its people's economy and environment; else they die. This means to sustain the planet.

To **prepare** is the third petal. What should the next generation of Chinese 'prepare'? Should they prepare cities that are designed primarily for cars? Regardless of energy sources, cars take up much space when being driven. Or should they design cities for trains or buses that follow specific routes? This action implies linear cities; cities laid out along the lines followed by train or bus routes. Is there time for that? Or should we hope for yet a different kind of transport? For example, should we hope for hanging cable cars can change from one line to another? (This is technically feasible, but such cars cannot carry weight like a railroad.) Should we hope for hanging cable cars that can steer themselves to various destinations and that can be made small, able to carry no more than four people?

To **provide** is the fourth petal. What should we, as a country or planet, 'provide'? As a practical matter, most wish to emulate the rich. What the rich have now becomes the goal of people in a productive society. Consequently, if the rich seek cars, then most will seek cars; if rich seek private jets, then when their society becomes rich enough, most will seek personal air transport, or air cars.

The control over what we 'provide' can be done with taxes, presuming a rule of law and not too much corruption. Rather than offer unscalable dreams for most people, the rich should be encouraged to seek alternatives that cause less damaging environmental impact. For example rather than hope that billions of humans can learn to live in traffic jams, we had better encourage the rich to desire 'private rail cars' again, or 'rented, computer controlled cars'. The numbers of this kind of vehicle can scale and eventually become available to every one, regardless of continent.

Voice and video communications mean that slower travel, such as dirigible or train, could become acceptable to the rich. But then, also, for others, vacations must be longer; or some other way for people to spend lots of time not at their work and not at their vacation destination.

Or would high density, low impact energy sources, such as small sized but powerful hydrogen fusion devices enable fast transport, such as by suborbital rocket, without having too much impact on the planet?

A major political issue is that damaging actions be prevented, but that the polity permit and provide for the unknown.

For example, the numbers of hot air balloons do not scale. They are noisy and clutter the sky. But a few are fine: they are fun both to ride and to watch. And an occasional large event is entertaining.

So the current policy in the U. S. with regard to hot air balloons is reasonable.

The current policy with regard to private cars is not. The numbers of cars fail to scale; yet, for good reason, people want cars. Some other equally convenient transport method is necessary, one that works in bad weather, unlike bicycles, and that works with the young, old, and the injured, unlike contemporary cars.

In empty lands, we can freshly design cities, suburbs, and rural areas for different modes of travel. But few lands are empty. Cities, suburbs, and rural areas already exist.

Deliberation is hard. That is why this chapter is called the *The Petals of Cooperation*. This is why the *the four Ps of politics*, the criteria by which judgements are made, in English are *protect*, *preserve*, *prepare*, and *provide*.

Not everyone has the time, interest, or ability to make judgements. But they, by existing, by being part of a historically accepted group, or (as in my 'third legislative body' suggestion) by paying taxes, can choose who shall deliberate and make decisions.

This is where the inner part becomes important: *reason*, *rigor*, *reality*, *responsibility*, and *honesty*.

Political deals must reasonably meet the situation. Rural areas, for example, may always need automobiles. A political analysis must be rigorous, otherwise, important elements will be forgot, elements that endanger the deal. Proposals must match reality; in an irreal world, people will irreversibly die. For example, any settlement involving aquifers must consider the long term, not merely to determine whether an aquifer will be depleted or poisoned, but also whether its use will change climate.

Thus, political discussions must be both responsible and honest. The people who undertake them need not be; their temperament is not relevant. But their actions are.

Details: the center of our flower. I am not going to discuss details since their deliberation is the task of legislatures. Legislatures must specify and decide on important details, and determine which are unimportant and would be left to civil servants and courts.

Together, all these conditions, criteria, and qualities mean to nurture the **true**, the **good**, and the **beautiful** (in that order, not the more usual order).

Discovering the 'true' means to figure out 'reality'. Such a search is practiced intensely by only a few, as I discuss in "What is Science?", page 70.

Moreover, as a practical matter, a matter of everyday convenience, most people accept as true those statements whose tellers they trust. (See "Trust", page 89.) That is why we must develop more mechanisms for determining trust.

The 'good' means to figure out a good way for an individual, family, and society to live. How to protect, sustain, and nurture.

In each of our different societies, in the United States or in China, the 'good' means figuring out what makes for the best city transport – cars or something else – and the geographic layout that such figuring implies. Since it takes decades to change patterns of building and behavior, perhaps the U. S. needs to come to depend on computer controlled small cars, since old people become dangerous drivers and since computer controlled vehicles will take up less space. Among other consequences, this either implies U. S. improvements in its local computer programming or yet more U. S. dependence on foreign computer programming.

The 'beautiful' means to figure out the social parts of life and the physical parts that individuals and communities seek, both built and natural.


PROTECT
RULE OF LAW
THE NEXT GENE
AND IT'S ENVIRONM
PREPARE
FREEDOM
FREEDOM TO
FREEDOM FR
LEARNIN

Concept Index

F

G

H

I

J

L

M

N

O

P

R

S

T

U

V

W

About the Author

Robert J. Chassell has an abiding interest in social and economic history. He writes and edits, teaches GNU Emacs, wrote an 'Introduction to Programming in Emacs Lisp', as well as 'Software Freedom: an Introduction'. He speaks throughout the world. He graduated from Cambridge University in England and flies his own airplane.