

Defence, Security and Resilience under Rapid Technological Change

Hardin Tibbs interviews Vinay Gupta

1) What do you see as the characteristic new properties of “cyber” (aka the Internet), the special features it exhibits or the effects/dynamics or issues that it gives rise to?

The cyber environment is gradually interpenetrating the real world. First laptops, then cell phones, now innovations like Google Glasses push the cyber environment further and further into our lives. Future innovations, like biocompatible materials, may take breakthroughs like the internet-connected pacemaker seem like mere stepping stones.

The brain is an information processor. The limit to this process should be clear: direct neural interfaces which make the cyber-environment into a literally real and tangible place, as real as the physical world to the users of such systems. How far out? 20 to 50 years. What's the defence implication: just what, exactly, in this future are we intended to defend, the physical body of the user, or their virtual environment? Furthermore, is progress towards this technology going to be fits-and-starts, a smooth continuous development, or a sudden breakthrough? What's the halfway point? The quarterway point? Has it already begun with prosthetics?

What about the role of government and governance in the cyber environment? In the light of bitcoin, what about taxation, and what are the possible impacts on the core functions of the State? How do the pervasive questions about the changing role of privacy look from your perspective? Finally, what about international governance, in the form of ICANN, the UN and other bodies which might lay claim to govern some part of how the internet functions?

When the SKU (Stock Keeping Unit) was invented, all physical goods sold in mainstream retail had a unique identifier. This was placed on barcodes, and a very great deal of the complexity and ambiguity was taken out of the retail environment. There was a definitive answer to "are these the same?" which was "do they have the same barcode?" which is to say "do they have the same SKU?"

Persons exist in a similar condition to goods before the SKU. While there are numbers, we lack a convenient interface like the barcode to put the number and the person in the same context. Biometrics helps, but they're expensive and difficult to get right. The problem is that so much of human life relies on a certain kind of ambiguity and lack of cross-correlation. We do not want our employers to know where we are on our lunch break if we are job hunting. We do not want our

spouse to know where we are shopping for a surprise present. We do not want our parents to know if we are gay, seeing a person of an outcaste group, or considering leaving the country. With globally unique identifiers, and the ability to search, tracking what people are doing may become as easy as looking up comparison pricing for a given book from a variety of shopping sites, as we do by typing an ISBN number into Google.

The implication is that people become more like things in our access to information about them; this is a transitory phase, where people had ambiguous names ("John Smith") and only the Government had access to the Number. But it's so convenient to have unique identifiers for things (twitter handles, email addresses, URLs, phone numbers) that globally unique names for people are inevitable. This moves some of the power of the State, to be able to uniquely identify people, into the hands of individuals. This ability to securely identify strangers is unique in human history and it is likely to have extremely surprising impacts as people adapt to it, which could take generations.

Perhaps privacy is to be protected at the search level, rather than the identity level?

The trend is inevitable, and the challenge to privacy as a concept is strategic, not tactical.

Consider a weapon which erased all electronic records in a State which had progressed far down this path. How much of the State would be left without identity records of its population? How much of the fabric of society would be erased when people could no longer find each-other online.

Therefore: how central to the function of the State is identity, and what happens when we (who are not the State) can identify people? How does this affect systems like voting? When we can all write into the Public Profile of people by talking about them in our own blogs and other digital spaces? The control of the vapour trail of information which follows a person was once the job of the State: "what's in your file, sonny Jim?"

Now everybody can do it. What's next?

How do you see the internet changing the fundamental internal functions of the State?

One of the critical functions of the State is the creation of artificial scarcity. For example, companies must have a unique name, and patent stops some people from using specific insights. One key form of scarcity the State creates is the shortage of money. The logic is very rational: gold is scarce, gold is money, money is scarce, therefore the State has to restrict the supply of "money" (in, say, the form of £20 notes) while the notes themselves could be mass-produced at minimal cost, perhaps 15p each. The prevention of the natural spread of £20 note manufacturing technology represents a considerable investment of police time.

If mathematics, specifically cryptography replaces the function of the State in creating artificial

scarcity, extremely interesting things happen to the cost landscape for those who wish to compete for the right to provide State-like services. No longer does one require the physical assets to produce artificial scarcity by force: mathematics can provide all the bottlenecking one requires to make a system in which certain forms of real scarcity are mapped to your chosen form of artificial "model" (or symbolic) scarcity.

Bitcoin, particularly, is very clearly angling to become the new Gold Standard, which would be a little less disturbing if *nobody knew who the author of the system is*. What is to be found or said about a post-scarcity environment is mostly science fiction. There is a key transition, however, from the physical rarity of Gold to the limit on the ability to use Force as the source "symbolic scarcity" through which the genuine scarcities of life are negotiated in a more efficient form than loading oxen into trucks to see if one can sell them at market.

If mathematics provides the scarcity, what's the State's job? This neglects the social role of creating standards and commissioning software, but we have to ask very clearly: what *can't* be done with mathematics as far as creating objectively verifiable models for various kinds of processes?

Why not model the State as a mathematical system, then implement it in software?

What about the role of new technology like robots and cyber weapons on conflict?

The path from the first thrown rock or stick held aloft leads directly to cybernetic and autonomous robot warriors stalking across the landscape doing the bidding of people safely in cities far, far away. How these systems are created is known: how they are guided is not. For example, if Hitler had access to drones, how might they have been used against the German population? What plucky countermeasures could have been taken against them? The use of ICT to carry the will of the State into semi-autonomous devices is a classic example of the enabling power of cyber.

What's not so clear is what the countermeasure, the reaction, is. There's never been a weapons so good there was no counter, and unless robot war constitutes the End of History (laudable but unlikely) we have to assume there will be counter-attacks. If the front line are robots and the chain of command in bunkers controlling the cybersystems by radio, the only vulnerable target in that political block will be civilian. An equilibrium of robot warriors retaliating against biological reprisals for previous attacks, resulting in a soft-targets war of political wills...

As we learned from Mutually Assured Destruction, even the winner can be a loser.

What about advances in the modeling and understanding of complex systems? What new options might open up there?

Weather changed when we could apply computers to large-scale simulations of weather

patterns, particularly when driven by swathes of accurate data from sensors, space based and sensor networks alike. About the only system which has similar amounts of monitoring that ordinary people have access to is the stock market, and that also is dominated by enormous computing power simulating and modelling possible outcomes, manoeuvring for advantage. Some of them even work.

How far is it possible to model human behaviour, given enough primary data? There is no doubt at all that a sufficiently advanced computer system could have caught the London Riots of 2011 from the data generated by the physical collocation of so many cellphones owned by a specific demographic combined with the call data as people relayed riot ideas to their networks attempting to sense the quorum of likely looters. In this instance they attained a critical mass online first, and then in the real world.

What happens if one simply pulls the plug on large scale social organization of groups using software to censor messages, much as China is doing today?

In short: given enough data, can there ever be a revolution?

How might the key actors - however you define them - change their political, strategic and tactical behavior in an environment with more sophisticated technology?

Encyclopedia Britannica is dying because an organized mob of experts, tens of thousands of people, have made a faster-moving, more tightly focussed interactive version. Britannica's role is not abolished but the shifting sands have moved the main traffic of human knowledge-seekers and knowledge-sharers to a new ecosystem, to a new niche. The result is one of the world's most venerable knowledge resources is dying.

Focussing on how existing actors will use cyber entirely missed the point. Most existing actors are being torn to pieces by the accelerating rate of change produced by technological acceleration.

If you credit WikiLeaks with the Arab Spring (the Guardian does, as leaked cables discredited leaders as puppets of the US in the eyes of their populations) foreign policy was being made by a network of perhaps less than two dozen activists, with more visible impact than the CIA has managed in several generations.

New actors. The old actors are too big, too slow and too safe to be able to use these resources effectively. Beating that problem will require them to learn how to make mistakes, but also how to play to their strengths while making those mistakes (from which one learns.) See "How to catch Heffalumps" from *Chess for Tigers* (by a Grandmaster called Simon Webb) for a very apt summary of this strategic situation

In chapter 5 on "How to catch Rabbits", the main points are 1. Keep it simple, 2. Don't

take unnecessary risks, 3. Don't overpress, 4. Have patience that your opponent will compound his mistakes. One quote that struck me is "It is always possible that he [opponent] will know a good line against your favorite sharp opening, or that you will end up by bamboozling yourself in the cut-and-thrust of a wild position."

In chapter 6 on "How to trap Heffalumps", the main points are 1. Head for a complicated position and hope that he makes a serious mistake before you do, 2. Play actively, 3. Randomize, 4. Complicate, and 5. Be brave.

<http://soapstonesstudio.blogspot.co.uk/2009/03/quagmire.html>

The Internet absolutely epitomizes Heffalump Snaring - a constantly moving, innovative system where a trend can capture two billion people in less than five years, which makes the speed of change of the State's best plans (war excepted) look glacial.

There's just no way the State can make a stand against Amazon.com and Google when it comes to ICT capacity because the civil service are largely cack-handed pre-tech bureaucrats. They can't even use the new tooling for security reasons (Twitter has added maybe 20% to my effectiveness) so they don't understand what they're being asked to regulate, or what the people are doing with these new technologies. Blackberry Messenger = riots? Who would have predicted it?

The kids. The Pentagon insisted on heavy crypto for the Blackberry, and the kids used it.

Could you expand on the new options open to key actors in this space other than the State?

Sneakers a 1990s Robert Redford / Ben Kingsly film posits a five way struggle between two intelligence agencies, organized crime, some hackers and regular law enforcement for control of a mathematical breakthrough. There is simply no better guide to the motivations and perspectives of the technocratic elite than this movie, and I must recommend it as required viewing for everybody involved in research on technology and security, along side reading Julian Assange's source text, *Shockwave Rider* and *Intelligent Listening for Beginners*, an episode of a long-gone 1980s British Sci-Fi drama *Star Cops*. While it might seem *extremely* odd to be recommending Dr Who level BBC science fiction from decades ago as a cutting edge resource for a 21st century investigation of the issues, I've never seen such an acute framing of "who actually speaks for (and through) the analytical software we deploy to monitor networks?" These questions of intention encapsulated in software are Poorly Understood and we have to turn to fiction to get fresh perspectives on them.

My definition of the State differs from the now-standard Weber definition about monopolies of violence. The State is what can retroactively pardon crimes; anybody who can get you off is the State, and that includes the possibility (indeed, the actuality) of multiple State actors at any given time. Mafias, intelligence agencies, even some corporations have State-like power when the

ability to immunize is understood as the core of the State's real reach.

The technocratic elite wonder why government won't save the world.

It's a pretty simple question. A much sharper grasp on science and engineering than is typical of voters or elected officials gives deeper insight into problems like climate change (and trivial issues like copyright) resulting in a continual frustration that the State, regardless of its origination as a democratic enterprise or an authoritarian one, is unable to Get It Right.

Stupid priorities, stupid power elites steering the general population over a cliff from which there may well be no return. Climate, biochipped-humans fascisms, nanobio grey goo meltdown...

Who, precisely, is on watch here?

And this is where the technocratic elites get involved. They clearly perceive the species-and-world threatening stupidity of current political decision-making and wonder if they could not do better. There are new modes of power (making machines to solve problems) and new political economies (open source, distributed manufacturing and so on.) But, most of all, there's a desire for sane, rational, evidence-based governance rather than uninformed, misled, incompetent voters putting whoever's advertising campaign was better into a position of absolute power.

Fate of the world. Who'd gamble on democracy to deliver, given the system of incentives it encodes for those in power, never mind the voters? We can't trust a system with such short-term interests to govern long-term risks. And we can't even have this discussion in public because democracy is a sacred cow.

What about the bigger picture relationships between the State, markets and democracy itself?

Feudalism took information to the center, and issued orders. Capitalism moved price information to the edges and allowed coordination, but lacked the capacity for the system to carry much more data than price. Networks replace mere price signalling with social embedded networked commerce where people trade by affinity and stories have objective negotiating value (my ability post things to 3K followers and 10K blog readers changes my ability to negotiate with many people.)

Voting looks very, very crude when put in this context. What replaces the current form of democracy, in the same way that Wikipedia is replacing Britannica? If the answer is supposed to be "nothing, we got this right 200 years ago and there's no need to change it" well, that's the kind of thinking which bankrupts businesses.

Nobody wants to see the State go bankrupt because it wasn't able to extend democracy to

encompass new avenues for collective decision-making. But what won't change will break in an age where relative prices between land and information have utterly transformed.

For context: the *most expensive home computer it is possible to buy* costs about the same as three months rent in London. Political economies from a time when information was expensive and land was cheap (the conditions of Representative Democracy) are simply no longer applicable. What comes next, I don't know, but change is certain.

The very concept of a market as an efficient system may soon be history. Consider "math trades" in which *global* rather than *local* optimization is applied to a trading situation. A typical instance is second hand board games: people list which games they would like to give away, and which games they would like to receive. Rather than trades being executed in sequential order, giving a *local minima* with dependency on the order in which trades were executed, math trades compute an enormous number of possible sequences of exchange, and pick the *global maxima* of possible satisfaction, giving as many people as possible the board games they wanted in the exchange.

If this sounds like a trivial example, they do the same thing for transplant kidneys.

The market is no longer efficient in an age of cheap communication. All that is built on it is soon going to be moot. Feudalism just could not compete with capitalism.

Here's the question: in light of how fast new things are built in the cyber environment, how soon could a coherent food-and-housing providing alternative to the traditional market form? Would we recognize it before it was huge? What would happen next?

This is why Bitcoin is not fundamentally interesting: it's a scarcity based currency, we've had those before. It might be harder to police, but it's not going to change the fundamental economic efficiency of society.

Cybersocialism or something like it will, and it's going to come faster than we imagine.

Could you expand on the impacts on the global economy, and how that affects governance?

(IX) The global economy is failing because existing institutions have moved so far out of line with basic economic reality, often dragged there by unrealistic expectations from voters and logjams in basic political structures within the target states, that it has become impossible to maintain what many consider to be the essential features of society in areas previously considered First World (such as Greece.)

This should come as no surprise. To quote Mondo 2000, a seminal cyberpunk magazine of the late 1980s at the fall of the Berlin Wall, "Communism was only the first to go." Ineffective

governance results in failing states, and the mayhem of destructive internal competition (outsourcing, banking crises) released by the fragmentation of society after the binding force of the Soviet Union collapsed has eaten the majority of the social capital left in our societies. The shattering of the basic social contract implied in (for example) the drying up of Detroit is emblematic of a far broader and wider collapse in basic social contracts. The Soviets held us together, and now we are falling apart. The rich have turned on the poor because they no longer fear the Reds using internal discontent for revolutionary purposes. The defence contractors rape the budget because they do not fear defeat. In the absence of a common enemy, capitalism freewheels like an engine without a governor, into its own crisis. Marx's analysis of the problems of Capitalism may well have been accurate, even if his proposed remedy lead to mass murder whenever it was studiously applied.

We are out of solutions from the past. We must import our answers from the future. The fight between those maintaining a collapsing status quo and those attempting to usher in a new age of renewal and regeneration is harshest at its most important battles, where (for example) the copyright lobby jails teenagers to try and prevent people using the internet in economically efficient ways.

What about the role of ICANN and similar global governing bodies? How do they provide for questions like civil rights, given that they are not elected bodies?

DNS requires roots, overlords which divide up a fixed, linear, analysable namespace (like the integers) into blocks (you own 999 to 1001). Because there's no real way to divide up these spaces in objective ways, there are no rivers to divide the landscape, and no way of sequencing claims as one might get in a landrush, but there is a distinct topology (routing) we're left with a simple question: who gets to control the scarcity, who decides who gets what?

The UN? The US? China? The EU?

The likely outcome is that the major political power blocs each make their own assignment, and then map between these assignments at the borders of their political reach, at which point we'll have effectively balkanized the most effective tool for global human understanding ever created.

Balkanize the internet, and fighting wars over it becomes entirely more plausible because there's a prospect of containing the damage to restricted areas in which a national interest is converged with a section of the topology. Part of what makes the internet safe is its unified nature, in that hitting any of it can bounce around in unexpected ways (for example, STUXNET/FLAME may well wind up arming an entire generation of hackers.)

Can we imagine a copyright-centric US Internet, a differently copyright-centric enforce-translations EU Internet, and a Socialist Chinese Internet which forbids all local storage and keeps everything in a giant government Cloud for easy inspection and censorship? Yes, quite easily. It's only been a unified, apolitical whole so far because nobody cared how it worked.

It was just back room boy techie business, and we made an egalitarian whole which served everybody, and therefore nobody, leaving little advantage to be extracted by our political masters.

Almost nothing survives this kind of politicization. Imagine how useful money would be if we used the same stuff globally. Imagine the scandal that would exist if a globalized Money was being balkanized for local gain. It's like that: a fundamentally useful utility is in danger of compromise specifically because it favours nobody but the individual, resulting in massive pressure being applied by all institutions. Nobody suggests, for example, turning internet governance over to a democracy of its users.

In fact, a perfectly good, politically incorruptible global financial standard did exist: gold. It gave insufficient wiggle room to the political powerful western countries, and they abandoned it in favour of fiat currency mostly unbacked by gold. The rest of the world would have stayed with gold and, in fact, if we had stayed on the Gold Standard there's a good chance none of the existing financial problems would exist because the markets would be fundamental non-volatile. "It's worth what we say it's worth" is not a compelling argument.

"Who gets to say what money is?" is exactly as good a question as what internet governance is. There's lot of ways to skin this rat, but fundamentally the parallel case is currency.

Balkanization is coming, unless there is a miracle. What kind of a miracle? Well, you could rebuild the internet on mathematical scarcity rather than fiat scarcity. Then it'd be more or less self-governing as long as the Three Letter Agencies stayed out of its esoteric mathematics looking for advantages. BitCoin's major contribution may be to understanding the nature of scarcity: a lousy currency, but a great inspiration.

Who's to say what The Internet really is, anyway. Is it what ICANN performs? Is it a routing? A cable format? And if the Internet was free of the shackles of namespace-management-by-the-state, would it finally be free? No, now it would be confined by social agreements between a worldfull of people (good luck shipping updates) and cold, hard math. This is not progress, and will not solve the collective action problem. It's *literally inhumane*.

Perhaps the State survives by peddling flexibility.

What about the structure of the economy itself? Is there another revolution here?

The decentralization of manufacturing results in a viable global economy which is almost entirely dependent on the internet for transmission of designs and coordination of complex multi-party manufacturing arrangements and supply chains. Lots of labour, lots of "jobs", relative material plenty, very, very refined materials-efficient manufacture at the cost of putting 10% of people behind lathes. Better than back to the land.

Cyber is now 10x more important because a hit on the general internet now hits as hard as a

blow to Ford and General Motor's Enterprise Resource Planning software. The internet does what money does now, and the "digital/economy" is so tightly interwoven that a rip anywhere bankrupts millions.

Stripped of its enriched information capacity, airlines cease to exist because they can no longer manage the complexity of the global operations, particularly the dynamics of actually making enough money on a fundamentally unprofitable business to keep the doors open using such trickery as demand pricing and all the rest of it. Now imagine a world in which buying a bicycle has a roughly equivalent amount of complexity, but its all handled by software on our behalf. If nothing goes wrong, it's great.

What about the other great bugaboo of our times, climate change? How will the environment you envisage help us manage the climate problem?

On a similar note, the only hope of tracking all contributions to the global environmental crisis is with pervasive monitoring of all vital systems. No basement incinerators in the slums of dangerous cities, or we simply have economic incentives to ship toxic waste out. One could ask a very pertinent question, "what's the minimal level of global monitoring required to enforce sane global environmental legislation?" The answer is a lot. Far more than anybody is comfortable with. But there is a profound question about the need for global environmental regulation and individual human liberty. Nobody's really willing to ask what freedoms have to be removed from the general population to get them back within a one planet footprint, but any kind of enforcement on that scale is going to require remote passive sensors and possibly active tracking. Market mechanisms lack the resolution to really understand destructive behaviours, and energy taxation is so regressive that few economies could survive it.

One must envisage more and more of this content being digitized (think "smart home" and "smart city" approaches) until all that remains is an environmental monitoring system which happens to emit sufficient real goods to sustain human life. Sounds like a joke, right? But at 6C of warming its going to become much, much clearer that what we do matters. People might favour depopulation before they'd put up with their cell phone telling them to sit without the lights on because they've used their daily carbon ration commuting to work... but then Facebook was pretty unthinkable too.

Talking of Facebook... it's rapidly growing, and soon will have more members than China has citizens. How might they use that position in the future?

Facebookocracy is governance by social network. Sounds like a joke? Facebook needs two things to be a serious competitor to the State, those being

- 1) an account-based currency, and
- 2) a voting system

As a direct challenge for programmers, implementing an account-based currency on top of Facebook's existing technical infrastructure is a fairly small project. It's about as hard as building an image gallery system that plays nicely with modern cell phones - Instagram, say, or Flickr. Currencies are not hard to do at a technical level, all we're talking about is conserving value by not letting people make value where none previously existed ("printing money.") It's a lot easier than DRM, for example, which is like trying to enforce the limitations of the material world on information systems. Non-replicability of a CD is easy to enforce if you think of a CD as a physical object which requires a CD-R blank. But if you think of the CD as a bitstream, the fundamental nature of computers is to duplicate bitstreams. The problem vanishes.

Likewise, voting systems are a minor variation on currencies. One vote is one dollar, and it needs to be spent anonymously. Votes are conserved, rather than currency units, otherwise it's much the same problem.

The hard part is getting billions of people to use your systems to the point where your identity database and trust relationship is strong enough to actually prevent vast numbers of fake people existing. But facial biometrics driven by *hundreds* of people taken from their early teens into full adulthood ought to be a solid enough corpus for any algorithm. Instead of creating scarcity using mathematics, Facebook (and similar groups) can create scarcity through biometrics, or rather *conservation of persons* which is critical for both banking and voting.

Facebook could build a larger trust network and integrated trading area than China in about six months. Given a global economic catastrophe, we may indeed discover "the empires of the future are empires of the mind."

After all, owning the hard identity credentials of people across national borders is the ultimate goal of groups like the United Nations - to issue passports, to control the relationship between the nation states. Do we all want to live in Zuck's World?

If not, the State (which is at least accountable, regardless of our problems with representation) had better figure out how to defend its people from an unaccountable elite which owns the infrastructure by which they connect with their friends and remember their pasts.

Some things are too important to be owned by free enterprise. Nationalize Facebook! Maybe the UN should take a look at that... if they weren't... so goddamned antidemocratic.

There are very few trustworthy and sane global players. The Nation State has work to do yet.

What about the limits? Where could all of this go at, say, the limit of the State's planning horizon?

Cybor end states consider our human limits in the long run. Trident was procured to last 30 years. Moore's law over 30 years increased computing power by roughly a factor of one million

times more processing power. Staring at the reasonable-to-expect technical base in 2040 gives a very simple picture: men-as-gods or sticks-and-stones. Let's pick off a few easy-to-see options.

- A) approximate simulation of an entire human body's worth of atoms, giving virtual people for medicine, drug testing and so on
- B) artificial general intelligence perhaps even including consciousness
- C) casual editing of DNA in living humans for well-defined effects ("holiday gills")
- D) direct neural interface between human beings allowing them to see into our minds
- E) disabled people with functional robot bodies

If we can't define what human is, what hope does the State have of defending its citizens? The US military processed this as Revolution in Military Affairs and the roboifonanobio revolution. But for cultural reasons, the idea of radical shifts in human identity do not go over so well in America. The idea of *posthumanity* frightens the best of us, but in the irreligious cultures of Old Europe it's much easier to see the faultlines. My cognitive environment would be unrecognizable without Twitter and email and the web, to what degree am I a cyborg? I'm addicted to the tools, as much as man has been addicted to writing since its beginning.

If we do not destroy ourselves, we are going to go straight off the maps of every old religion, and into an unimaginable future. At 40, I can expect to see most of this happen. Hard problems like space travel are slow to move, but everything which is soluble in transistors is going to go down to a million-fold increase in available computer power. And that's most of our complex systems problems (weather modeling, gene expression and so on) and simulations which run over every single member of the human race.

Who is best able to adapt to these environments, and why is it impossible to hire them for military work? The archetype of the straight-laced soldier admits little of the fluidity of identity required to navigate a world where you may be required to redefine what is human, to extend human rights to robots, and the whole panoply of RAND/Hard Sci futures. The difference is that these ones are actually happening. We lack imagination, but not knowledge.

It's coming, who shall greet it, or what?

Surely with these kinds of technologies, many or most of our core problems as a species - things like disease or natural resource constraints - simply go away? Or are there confining downsides to consider?

In this world, everybody gets a free college education over the internet. Everybody gets personalized healthcare from genomics and clever massive-compute body scanners which may bring MRI and CAT within the range; cheap, safe digital medial equipment.

The problem is that one brat with a smallpox genome and a spare printer.

If people do not become good, they are going to have to be enslaved for their own protection.

(XVI) The final choice is between enslaving our the population to protect them from their own power (in the form of, particularly, biological weapons created with digital manufacturing techniques - gene printers and protein factories) and improving the human condition so much that nobody cares enough to pick up the swords which litter the landscape in a power with such enormous power in the hands of individuals. Direct modification of the human genome to breed out aggression might be typical of the sorts of insanity contemplated as we get closer and closer to the razor's edge: the digitization of life itself, allowing computer viruses to smoothly become biological viruses if they can only find the right peripheral to download themselves into physical form through.

You can already have bits of DNA made to order on the internet. The digitization of life itself is coming, with unknown and unintended consequences.