

Surviving the Cyber Age

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by Fred Cohen, Ph.D.

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Front matter

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Forward

How to stay below the radar

If they want you they can get you. So try to make sure they don't want you... or at least that they don't know they want you... or that they think they know they don't want you... or...

Prelude

I have become increasingly concerned for the well being of multiple clients and ultimately everyone else who are under cyber-related and physical threat to their personal safety, financial assets, and ability to live their lives free of fear. This has come about because of the emergence of the cyber age. Like the information age had a dramatic effect on the world, as did the industrial age before it, and did the many ages before those, the emerging age of cybernetic systems is having and will continue to have a dramatic effect on the future for all humans, and indirectly, everything else we come into direct or indirect contact with.

This book is intended to address the related issues from a more thorough perspective than the individual articles I have written on related items over the years. It starts with an overview of the big issues, and then rapidly drills down into the minutia of mechanisms, eventually rolling back up into the overarching challenges we face and the things we can do to survive them.

But to be clear, "Nobody gets out of here alive!" We will all likely be long dead before the end of the cyber age. Consider that cybernetic systems have been around since before we were born, and they are likely to be here long after we, as individuals, are dead. But I am getting ahead of myself, which is quite a trick considering I might end up unable or unwilling to continue before I reach the place I am getting to... which brings me to time travel...

As it turns out, it's not really that hard to travel forward in time, we all do it every day. But going back seems very difficult and highly unlikely to happen. Because if it could happen (or had happened) for me, I would already have traveled back and prevented the situation we are all in now. But in any case, moving forward...

Foundations

Cybernetic systems are composed of sensors, actuators, communications, and controls. They are composites made of components, and composites of cybernetic systems are themselves also cybernetic systems. The components are real physical things, and thus so are the composites. Physicality implies limitations and boundaries in space and time, granularity, sensitivity, precision, accuracy, operational temperatures, pressures, and any number of other parameters. They occur in nature as a result of the nature of the universe, and as a result of the nature of the universe, people have emerged and are such composites, and people create their own artifacts, many of which are also such composites. As societies emerged they were also composites of people and things and are also cybernetic systems.

As a result of mathematics, science, and engineering we have devices of our creation that now exceed our own capabilities to do these things, and increasingly can act on their own as independent cybernetic systems, at least for a time, and eventually likely without us.

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Thus we enter the cyber age

Given that artifacts we create may start to sustain themselves without us, they will no longer need us to sustain them, and there is the potential that we will no longer persist while they remain. I am against this, and this book is about surviving this potential eventuality.

But it's about more than that. Because even if this never takes place, or if it does, long before it takes place, humanity has entered an age when a small number of people can do more harm to more people than ever before, and they can do so without the physicality of brutal warfare, as well as by leveraging this brutality in conjunction with unprecedented automation.

In a very real sense, automation means amplification, and the realization of amplification of select individuals' influence over events at a finer granularity brings an unprecedented capacity for a very small number of people taking advantage of a very large number of people without the knowing support of the masses historically required for control.

The arc of history has moved from on-on-one or small groups combating each other physically through the age of fiefdoms and kingdoms with their hierarchical structures of power and force, to industrial age concepts of all-out-war and mass casualties, to the chemical, biological, and nuclear age of weapons of mass destruction killing large populations in single events, to the information age of controlled targeting of lesser weapons in group activities at a rapid pace, to the cybernetic age where we can kill specific targets at the granularity of individual people identified and located by intelligence processes and executed by complex global cybernetic systems from afar.

The arc of history has also produced a glorious life and potential future for individuals and humanity as a whole. No king or ruler of 100 years ago lived as good a life as millions, perhaps even billions of people do today. Many of us live longer, healthier lives with less disease and fewer deaths or other harmful effects from those diseases. We can go where we want, do what we want, say what we want, and do it when we want, all within broad limits, all in relative safety, in much of the World. Medicine is far better than it ever has been, diseases are being overcome in increasing numbers, a wider variety of healthier food and drink is more widely available at a lower cost. Clothing and housing is safer, longer lasting, nicer to use, and easier to manage than ever before. Communication is nearly instant to anywhere in the world at a rate far exceeding anything in the imagination of historical communities. In summary, we have reached heights of ease, convenience, health, safety, and options to live free beyond anything available 100 years ago for most of the people on Earth.

And it looks like we may have burned ourselves out on it. As crazy as it seems, in the new age of reason and enlightenment, we are losing our reasoning in favor of irrationality. As has happened in age after age, the wealthy and powerful have greed beyond sanity, and have decided to destroy the benefits to most of us for the temporary advantage of a few of us, and have started to do so to good effect by sowing ignorance, discontent, and hatred through deception. In rewriting history in front of our eyes, they have leveraged and increasingly further leverage cybernetic systems to influence masses to act against their own interest in the perceived notion that somehow the past was better, differences that don't matter should matter, similarities that do matter should not matter, and by creating worsening life situations, dividing and conquering the populations of the world. It is not an accident; it is a well executed plan being supported by more and more of the 'elite' claiming to be 'of the people', and being done for their own temporary wealth and feelings of superiority. It is a sickness.

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It's already underway

We are past the peak of this age of enlightenment. The systematic sowing of distrust in science and engineering combined with the deprecation of social, moral, and legal controls and destruction of institutions has led to the insanity of such things as stopping the development and deployment of vaccines to stop diseases, deciding to ignore things that the people in power don't like or want you to know about, co-opting of the media moguls in consolidated destruction of fact-based information, destruction of record-keeping mechanisms to prevent attribution of actors to their acts and disclaim the acts themselves, and even to the mass generation and distribution of complete fabrications presented with greater authority than historical fact can possibly support or rationality can be contorted to allow.

Massive layoffs underway in the age of Generative AI provide a microcosm of the burnout of science, engineering, mathematics, and societies' desire and capacity to continue to further enlightenment. This is among the craziest things in the cyber age, and it mimics in a lot of ways a movie called "Idiotocracy", in which idiots come to dominate the planet and as a result, humanity all but extinguishes itself out of pure commercialism to the extreme of stupidity. Here's the deal:

- Massive layoffs of scientists and engineers in key areas like biology, disease control, warning for severe weather, planetary science, and so forth.
- Destruction or concealment of databases that have the data to make good judgments about scientific issues, and cessation of collection of data to populate those databases.
- Replacement of analysts and their analytical mechanisms with Generative AI that can rapidly and inexpensively generate reports that look and sound to the casual observer like the reports previously made using science and mathematics, but are just made up word sequences representing what the people in power want them to say.

Regardless of the pure bunk of the results produced, the real harm comes from the fact that the scientists studying these fields will have to earn a living elsewhere, which means they will not be up to date on the science, or perhaps the science will not be updated at all. It will just stop, and along with it, the progress it brings. Instead of growing the pool of people working on further enlightenment as the benefits of the age of enlightenment continue to show up, the pool of people working the issues is reduced, producing a lessening of enlightenment, and more importantly, the pool of people capable of moving things forward. We are losing a whole generation of folks who will bring along the next generation of folks, and if we keep it up, there will be nobody left who knows how it really works or can make it work. As we eat the seed corn, we will run out of corn.

If we did this for the building trades, we would no longer be able to build safe houses or buildings in 35 years. If we did this in the transportation industry, we would no longer have safety flying from place to place or the ability to drive across the fallen bridges. If we did this in the power industry, we would end up in blackouts more and more of the time. If we did this in farming, we would no longer have healthy foods to eat. And as it turns out, we are doing this in many of these industries to a greater or lesser extent. We are dumbing down the education and training for many areas of trades, and if we are not careful, we will run out of capacity to proceed. The inability to support the population ultimately leads to its thinning, which is to say massive die offs, reduced life spans, more worse diseases, pestilence, pollution, etc.

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Start by assuring your survival

Your (and our) survival depends on the usable preservation and ongoing advancement of know how. At a minimum, we need to not forget what we already know and be able to keep using it. It would be much better to continue to advance it. But let's be frank. The whole world is not going through the insanity of the US. China, for one, is continuing to advance in areas the US is dropping off in, and has a good shot at passing the US in science and engineering in the coming years. The migration of scientists and engineers is often called a brain drain, and where the US has been draining the brains of the World for decades, the flow is starting to reverse itself. Canada is taking up some of the slack, but Europe is having its own problems with political foolishness, and many of the so-called 3rd world countries have limited resources to support growth in these areas. In the aggregate, the people of the World seem to be getting less motivated and less well educated. Laziness in the face of opulence seems to be the human response.

Motivating populations toward advancements in science and engineering is critical to long-term progress and ultimately survival for humanity, if only because the Sun will some day become a Red Giant and absorb the Earth. But the arts and literature are also in decline. Not by volume for sure, as more depictions, sound sequences, and more word sequences are generated today than ever before. In fact, and of course, computers can generate all of these. Smell-a-vision and tactile devices are also available, but not (yet) as popular or voluminous. But notice I did not say music, works of art, or literature. The art is the part where feelings and emotions are expressed and communicated. The more we automate, the more we systematize, and the less we reflect real emotion, feelings, and personal communications. But don't mistake this for the inability of automation to produce depictions in all these forms that seem to hold emotion, feelings, or personal connections. We anthropomorphize (treat as human) things we observe from computers and they induce feelings in us. Well controlled feelings, better controlled every day as we progress in the evolution of cybernetics.

The use of automation for motivation is a multiple-edged sword. Today it is being used to motivate people against each other into cliques, to divide society, to sell them things they don't need and keep them from canceling recurring revenue payments to unknown entities. It is being used to sow misinformation and disinformation, to rewrite history, to drive populations toward conflict that wealthy folks can use to advantage. It is driving people away from education, into believing that bad things are coming their way, into distrust for others, and into self-indulgence. In some cases it is driving people toward suicide or homicide, overeating, laziness, away from science, and so forth.

But it doesn't have to be this way. It is this way because of the increased centralization of control over emerging technology driven by the enormous wealth it has created in a few people. But the emergence of the Internet and the information age was successful because of its decentralized nature and the lack of control over it at the endpoints. The struggle for freedom in the cyber environment is ultimately one between centralization and distribution of control. Cybersecurity is being used in many places to centralize control, which is limiting both the capacity to innovate and the ability to break free of the rich and powerful. But it doesn't take much knowledge to operate on your own and largely defeat these central control schemes, and plenty of folks are offering the capacity to do so by sharing their own efforts, and the success of the so-called open source movement is a major reflection of this. More cell phones, laptops, and data centers now run open source than closed source.

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Information needs to be free... or at least inexpensive

It's the ridiculous assertion of radicals in the leakage trade that information needs to be free, but of course they pay for their devices, access, and content, just like the rest of us. Yes, I know I am mixing metaphors. Freedom of information is about transparency, not about cost, but on the other hand, people need to get paid in today's World in order to live the good life we have created as societies. The communist ideal has never succeeded, nor has the democratic ideal. From a practical standpoint, we live in a world of imperfection, and while we may spend our lives seeking to perfect it, it is a goal we can never completely achieve. Nor can we shy away from continuing to pursue it and hope to continue to live the good life.

It is the widespread availability of true information that we need to succeed. And while some may believe that there is no ground truth, I for one believe in objective reality. But even if you don't, you can still see what's in front of you and hear the vibrations that hit your senses, even if you hear what you want to hear and see what you want to see. Because the inherent incompatibility of wrong interpretations and projections ultimately become irreconcilable other than through willful ignorance, most of us will eventually adapt to falsification with new understanding. And that is at the heart of the scientific method. The willingness to accept that our theories are or may be imperfect and the requirement to not ignore falsifications, but rather to embrace their reconciliation by adapting our theories or methods of testing them.

Perspective often helps understand things. For example, the Influenza pandemic in and around 1918 killed about 50M people worldwide, or about 3% of the World population at the time. The COVID-19 pandemic is estimated to have killed about 0.1% of the World population at that time. This represents a factor of 30 improvement in survival from emergent infectious diseases, and that's in the presence of far more rapid transportation for rapid global spread in the 2020s. But today, only a few years later, we are seeing the re-emergence of Polio, which was completely eliminated in the 20th century, because of back peddling on immunization efforts. How then can this happen? It's because of the spread of false information about vaccination.

Social dominance is not the same as technological dominance, but they are intertwined. There is an old saying that a lie can get half way 'round the world before the truth gets its pants on. Also note that half way in all directions ends up being all the way because we live in an approximately spherical planet – unless you are still in the flat Earth society, in which case the whole 'round thing is problematic.

In the information age, technological dominance started to lead to social dominance because of the leverage of technology for information dissemination. But as things happened and tend to happen, the free expression of the early Internet has been increasingly quelled as the corporate interests and governmental agencies of controlling societies have started to enforce their control, leading to social dominance, which is their goal in gaining and maintaining power and wealth.

In the cyber age, things are getting worse quickly because of the ability to use the feedback available from the dramatic increase in sensor technology. The increased capabilities of sensors combined with the ability to communicate the sensed information rapidly, use it in a better automated control mechanism, and rapidly deploy actuators through communication mechanisms provides for an ever tightening OODA loop (Observe, Orient, Decide, Act) allowing for individualized real-time control over observables for enhanced influence.

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Building the cybernetic narrative control loop

Technological dominance is a battle over time at all levels of human endeavor. Most of the technologies today are available to almost everybody in many societies. While there are various controls over some sensitive technologies, theft and smuggling regularly bypass these controls today, and with the advanced manufacturing capabilities of additive (e.g., 3D printing) and subtractive manufacturing available to anyone willing to spend a few hundred dollars, some version of most capabilities can be had at small scale, at least for experimental purposes. Individuals regularly build genetic sequences in home labs, insert them into cells, or do other similar mutation experiments. Most chemicals are readily available or easily constructable, and a good chemist can likely get you what you want. Plant and animal matter is in the environment all around us, and we can buy seeds, multiply them in our own gardens under controlled conditions, and use them as desired.

All of these are automatically controlled and repeatably implemented at low cost in cybernetic systems that hobbyists construct and use every day. Because of the low local cost and ease of reproduction, we get scalability, which includes distributed construction and manufacturing at any location, in parts or as a whole, as long as we can communicate the process required to create the cybernetic composites out of components. So the information age leads to the cybernetic age for distributed cybernetic generation of components and composites. Among those composites are things like drones for transportation, electronics for communication and control facilities, and sensors and actuators of all sorts, all generable and distributable at any scale within the joint capacity of the distributed cybernetically engaged societies we create.

Social dominance is a different issue. It depends largely on control over the narratives of social groups. At scale, that has been achieved first through large human hierarchies, then at larger scale and in shorter time frames through, largely broadcast, mass media. Usenet News groups were early instances of distributed information dissemination nodes in the early distributed networking environment before the Internet, based on individually operated bulletin board systems distributing what they wanted to whoever wanted to access it. The Internet for now has largely swamped this by its vast social media platforms with billions of people being influenced and central control.

As social platforms became increasingly dominant, they started to run into the narrative control problem. Security started to function as the gateway to acceptable content, or more precisely, control over allowable narratives. Analytical AI was invoked for detection and automated response. Then the scientists seeking automated intelligence pushed the longstanding automated generation processes to an extreme by using all the content sucked up from all of their sources to create patterns of communication likely to convince people of whatever they wanted the people convinced of. The social influencers of old were lost for a while, but then they figured out that with the new generation of Generative AI and analytical capabilities to detect when influence was what they wanted, they co-opted the influence machines for creating and sustaining their own narratives. The lack of factual accuracy or any sort of sensibility was unimportant since no amount of fact checking could override the telling of a good story by a compelling story teller.

And so the modern cybernetic narrative control loop on social beliefs has come to be, and it is centrally controlled by wealthy and powerful people at scale. But it resides in the context of distributed technical capacities of the population writ large, which can potentially disrupt it.

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Rebuilding the distributed cybernetic narrative control loop

Survival in the cyber age will depend on our ability as a global community to come to grips with narrative integrity. That is, regardless of who is in control of what, the overall system has to have adequate integrity for survival. For my purposes, integrity generally includes accurate attribution of source and method of production to meaningfully unaltered content, and that the content is reflective of the reality it purports to present. Narrative integrity is integrity applied to narratives, or in other words, stories.

The information we get and bring into our thinking, to the extent it is not clearly part of a fantasy or fiction, should be reflective of reality, properly attributed to its source, unaltered on its way to us, and we should be able to trust it as suitable to its purpose.

We clearly cannot do this with central control because history shows it is altered to suit the greed of the central controller. And we really cannot trust any individual without limits in any case, because people are imperfect. The way we get to reliability is through redundancy, reasoning, and repeatable experimentation. The way we get to narrative integrity is to support multiple views but associate those views with their sources, motives, histories, and related stories. How they came to be, how they came to me, and what I did with them.

You can fool most of the people some of the time, and some of the people most of the time, but fool me twice, shame on me. This is the notion behind reputation, one of the many areas where scalability requires technology. Cheaters get past technology systems, particularly when centralized and the central controller is the cheater. Distributed systems can also be cheated, but it tends to be harder to do, especially when the redundancy is separate and different at multiple levels of the technology 'stack'.

The basic concept of distributed narrative integrity is that we should all be keeping track of our part of the puzzle of how content comes to be, how it comes to us, and what we do with it, and provide transparency into that process so that others can tell whether and to what extent to trust our versions... and we can do the same for them. The cybernetic system this forms is one that uses a feedback system to sense narratives, communicate them, analyze them, and produce narratives supporting our ideas in narrative form. In the marketplace of ideas, automating the association of integrity to the narratives and giving people choice about what they express and consume, allows all of us to independently choose what we want, instead of being forced into what others want us to perceive. Some will be more popular, but reduction of artificial amplification by distribution of mechanism will allow the marketplace of ideas to flourish and support fantasy, fiction, and fact with clarity around which is which.

The underlying concepts here are transparency, resiliency, diversity, and integrity. The time to transparency is critical in eliminating the time delay between deceptions and their revelation, and ideally every deceptive element is labeled as such as the content is first and always revealed to any observer. The resilience of the system is what assures that it cannot be disrupted as a whole in a short time frame, and that when disrupted, the system fixes itself, or at least fails gracefully so that its most important functions continue even as less important ones fail. The diversity of the system assures that it cannot be subverted as a whole in a short time frame because it is composed of separate and different components and composites in varying combinations so that no single (or set of N more generally) subverted components cause the system to fail to achieve its purpose. Integrity of content is supported by these aspects and augmented by the attribution of actions to actors and their histories in context.

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The context

Information only has meaning in context. Another way to say this is that you see what you want to see and hear what you want to hear. Another way to say this is that the bit sequences operate within the finite state machines that process them. The context of this book ranges from the physics of cybernetic system components to the influences of content on societies. The time frames range from below a nanosecond to millennia. The spacial ranges run from below a nanometer to light-millennia (a measure of distance – how far light travels over the time frame). As such, I hope I am stretching your mind as much as I am trying to stretch mine. The fields it relates to are every field of human endeavor, and possibly even fields not yet invented. The statements range from broad and sweeping to narrow and specific. Hopefully we will not all get lost and fail to keep sight of the objective.

The objective

My goal is to help as many of us as I can to survive and thrive in the cyber age. Your goal may differ significantly. Assuming there is a substantial population of readers out there, likely to include artificial intelligence mechanisms now and into the future, goals will range from trying to survive and thrive yourself, trying to help others survive and thrive, trying to figure out how to prevent such survival and thriving, defeating the goals of creating the sorts of composites discussed, seeking whatever other objectives you have been programmed or learned to seek, or just random reading to provide grist for whatever mill you may have or be.

To accomplish this, I will try throughout the rest of the book to provide references to attribute assertions to sources, provide low time to transparency, and provide pointers to places you can find more information that is more true to its origins than my narratives may provide. Where I don't provide such references, it is likely because of my laziness, lack of total recall, or the fact that I came up with it myself or copied it from some other thing I previously wrote.

Threat assumptions

When I talk about surviving and thriving, there is an inherent competition in today's world, and as far as I can tell, it will continue for the indefinite future as it has for the indefinite past. From my perspective, this is a threat against me and mine, and from your perspective, it is a threat against you and yours.

For the purpose of this book, I am going to assume the threat is about as bad as it can get. A very well resourced entity with group or government support or control focused on you, no regard for law or civility, willing to do almost anything to find and harm you, but still finite and bounded by realities of today and the near future. Along the way I hope to comment on the limitations of threats and defenders. Hopefully you will not need to apply all of the things I describe, and of course defenses also take resources, which I hope to identify along the way.

Also note the black and white nature of this approach. You are assumed to be the Good one and they are assumed to be the Bad one(s), but then it's really just a matter of perspective. And the book itself is only black markings on a white background. You grok what you want to grok.

In the meanwhile, stay safe and fear not. It's not paranoia if they really are out to get you.