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Introduction: Technology and Human Finitude

Introduction

Finitude is an important theme in both the Judaic and Greek sources of the Western ethical tradition. The Bible describes humans as created beings and as such they are enjoined not to worship false gods they have themselves created. The command "Know Thyself," inscribed on the temple of the Oracle of Delphi, instructed human beings to recognize their mortality and not strive beyond their natural limits. The Greek word for such overweening striving is *hubris*. The critique of *hubris* is the basis for an ethic and a politics of technology.

The more successful our technology, the stronger the temptation to violate the ancient wisdom. Technology gives the illusion of godlike power to master nature and bend it to our will. Dreams of absolute technologies have haunted the human race ever since Archimedes claimed he could move the world if only he had a long enough lever and a place to stand. Contemporary technological fantasies are no less extreme. We are told that we will soon be replaced by artificial intelligence, download our brains into computers, geo-engineer the climate, move asteroids out of their orbits, colonize mars, and more. The most important role for ethics in a technological society is to identify and avoid such *hubris*.

The environmental crisis reminds us that we are not gods but limited beings. A dramatic example of this realization occurred in the life J. Robert Oppenheimer, the leader of the Manhattan project in World War II. As he witnessed the test of the first atom bomb in the New Mexico desert, a phrase from the *Baghavad-Gita* flashed through his mind: "I have become death, destroyer of worlds."[1] Death, or Shiva, is the God of destruction and for a brief moment Oppenheimer identified himself with that God. However, very soon afterward he realized that the destroyer can be destroyed, that neither he nor even a well-armed America enjoy divine omnipotence. He soon advocated negotiations with the Soviet Union to limit the spread of nuclear weapons.

In what follows, I will treat the theme of finitude ontologically and epistemologically. Ontological finitude deals with the nature of technology and our nature as human beings. Epistemological finitude has to do with what we can know. In conclusion I will argue that recognition of finitude implies a democratic ethic of technology and a new concept of nature.

Ontological Finitude

Ontologically considered, all living beings have limits and belong to an environmental niche outside of which they break up and die. The extraordinary power of human beings to modify their niche supports the illusion of independence from the natural world.

Finitude is evident in the structure of human action. For the most part, actors obey a metaphoric equivalent of Newton's Third Law of motion according to which every action causes an equal and opposite reaction. This law is verified whenever two billiard balls bounce off each other, and also by much human behavior. It most obviously applies in interpersonal relations where anger evokes anger, kindness elicits kindness, and so on. Our acts return to us in some form from the Other. In acting we become the object of reciprocal action. This is the paradox of action.

As humans we can only act on a system to which we ourselves belong. Any change we make in the system affects us, too. This is the practical significance of our corporeal and social being. We exist in a world of causal powers and meanings we do not fully control. Our body exposes us to the laws of nature. And we are born into a cultural world we largely take for granted. In short, we are finite beings. Our finitude shows up in the reciprocity of action and reaction.

But technical action appears to be non-Newtonian. When we act technically on an object we experience very little feedback, certainly nothing proportionate to our impact. This gives rise to the illusion of technology: the subject is blinded to connectedness and understands itself to be autonomous, independent of the world in which it acts. This illusion is less prevalent in traditional societies. Where craft knowledge and everyday experience are in constant communication, the lessons learned from the use of technical devices are absorbed into the tradition and restrict technical activity to a few customary types. From a modern standpoint this appears to obstruct development, but our recent experience with technologies such as nuclear energy and toxic chemicals indicate the wisdom of restraint.

Most modern technology developed under a different dispensation from craft. In a capitalist society, control of technology is transferred from craftsmen to the owners of enterprise and their agents. Capitalist enterprise is unusual among social institutions in having a very narrow goal: profit. The freedom to pursue that goal is not inhibited by regard for the social and natural environment; the lessons of experience are ignored. Throughout the industrialization process workers and others subject to its side-effects are silenced. Technological development proceeds unimpeded, guided by sophisticated technical disciplines.[2]

The illusion of technology complements the narrow focus of capitalism and together they assure us that we can act on the world without consequence for ourselves. But only God can act on objects from outside the world, outside the system on which He acts. All human action, including technical action, exposes the actor to causal feedback and effects of meaning.

Consider, for instance, the indifference to side-effects which arises from the power of technical action to dissipate or defer causal feedback. Indeed, the whole point of technology is to change the world more than the actor. It is no accident that the gun kills the rabbit but not the hunter, that the hammer transforms the stack of lumber but not the carpenter. Tools are designed to focus power outward, on the world, while protecting the tool-user from the Newtonian equal and opposite reaction.

But Newton cannot be defied forever. As natural beings, we eventually experience all the causal impacts of our technology, including its waste products. But attention to this nagging aspect of technology is obscured by the seductive illusion of technology. My metaphoric version of Newton's law, however, states that the feedback that is initially ignored comes into play with a wider or longer range view. In the case of pollution, Barry Commoner's ecological corollary of Newton's law declares that "Everything must go somewhere."[3] Indeed, all the poisons produced by industry end up in someone's backyard even if it takes years to notice. As technology grows more powerful, its negative side-effects become more difficult to ignore and today they are impossible to deny.

Our actions not only come back to haunt us through causal feedback, they also change the meaning of our world. New technologies of transportation and communication offer dramatic examples. Railroads, automobiles and airplanes have radically diminished the experience of distance. The spatial coordinates of our lives, the “far” and the “near,” are completely different from what they were for our ancestors. Electronic communication has similarly radical consequences as a multicultural world emerges from the monocultures of old. Thanks to movies, personal encounters with immigrants and tourism, ordinary people today know more about foreign lands and cultures than all but a few adventurers and colonial administrators a century ago. What is more, the familiar distinctions between public and private, work and home, are subverted as new technology brings the office into domestic life and pushes creative endeavors and private fantasies into public arenas.

Even the meaning of nature is subject to technological transformation. Consider the example of ultrasound, which identifies the sex of the fetus early in pregnancy. In the United States, relatively few parents abort fetuses because of their sex, but the fact that this is possible transforms an act of God into a human choice. What formerly was a matter of chance can now be planned. Even choosing not to seek or use the information has become a choice in favor of "nature" whereas before no choice was involved. Our society has technologized reproduction and has thus changed its meaning for everyone, including those who abjure reproductive technology.[4]

The paradox of action also holds in the case of identity. The hunter kills a rabbit with his gun and feels only the slight kickback from his weapon. But the action does have consequences for the human, too: he is defined as a hunter insofar as he hunts. This reverse action of technology on identity characterizes everyone's productive activity. In sum, you are what you do.

Consumer society has further consequences for the question of identity. The tools we employ in daily life are not merely useful. They also tell us what kind of people we are. We now "wear" our automobiles, tablets and smartphones as forms of self-presentation just as we wear clothes and jewelry. Today, not only are you what you do, but even more emphatically you are what you buy.

This has unfortunate consequences. For example, automobile ownership involves far more than transportation. It symbolizes the owner's status and usurps the role that ought to be played by public transportation. In poor countries, it has an even greater symbolic charge than in rich ones, signifying the achievement of modernity and its vision of prosperity. But that vision must be lived under darkened skies in unbreathable air, a plague that has spread around the globe from Los Angeles and London to São Paolo and Beijing.

In such cases the means are not separate from the ends. Where identity is at stake, possession of the means is already an end in itself. Indeed, assuming a new identity is often the most important effect of technological change, more important than its ostensible, prosaic purpose.

These examples show how deeply we are implicated in the technologies we create. In the twentieth century, these ever more powerful technologies achieve the status of what Michel Serres calls "world objects," that is, objects that affect the world as a whole and not just a small corner of it.[5] The first such world object was the atom bomb. But even as the atom bomb dramatized human power, fossil fuels were quietly altering the climate. Getting these world objects under control has proven extraordinarily difficult. We control the world with technology but do we control ourselves?

Epistemological Finitude

Epistemological finitude has to do with the limits of human knowledge. Our ideal of objectivity is a view from nowhere, a God's eye view of the universe of the sort that we imagine science provides. But knowing is both made possible and limited by time, place, body, culture, prejudices, and all the other contingencies that operate in the search for truth. The philosophical doctrine that grants these limits without denying the possibility of knowledge is called fallibilism.

Fallibilism applies to technology as to every other form of knowledge. Technical disciplines are influenced by traditions and interests and inevitably contain errors. These limits show up in the flaws of technological designs, which may be biased to privilege the interests of a given social group or may contain unsuspected dangers for those who use them.

Chapter 1 discusses the bias of technology. It is often embedded innocently in the blind spots of tradition. Technical designs that appear neutral may actually embody an unconscious preference. Right-handed tools offer a good example. Scissors that are easy to use with the right hand are clumsy in the left hand. The early makers of scissors were likely right-handed and no doubt unaware of the problem. Similarly, sidewalks with curbs at intersections obstruct the movement of wheelchairs. In recognition of the rights of the disabled, sidewalk ramps have been introduced everywhere in North America. Again, the designers of traditional sidewalks can hardly be blamed for their oversight. The ordinary high curb is no problem for pedestrians. The real question is not technical but asks whether disability is a matter of private or public concern. In such cases the bias is hidden in a technical specification that cannot be suspected of fostering prejudice or self-interest. Yet the apparently innocent specification is biased.

The case is more complicated when interests are involved. Class interest interacts with machine design in the course of the industrial revolution. Here intention is at work, translated into biased technical specifications that represent the demands of owners and managers for the de-skilling of labor and mechanization. I will return to this case in chapter 1.

Experts hand down these biases from generation to generation. Criticism is difficult insofar as the problems are encoded within technical disciplines independent of public opinion. Even so, progress may come from outside the tradition-bound technical fields. Protests, controversies, boycotts and hacking challenge bias and make it visible.

Technical accidents play a role too, as in the example of Fukushima Daiichi. Nuclear power is an exceptional case at the limit of technically feasibility. But just for that reason this is a revealing incident that makes clear the importance of fallibilism in technical culture.

The Fukushima disaster shows that there are technical problems that are simply too hard to solve. Of course, provisional solutions may be found but we need permanent ones. When dealing with any complex system, we arrive at such permanent solutions only through experiencing, analyzing, and responding to a succession of unanticipated problems and accidents. This is what the aircraft industry has done over time and as a result flying is now quite safe.[6] The consequences of such a succession of accidents with nuclear power are simply too costly and frightening.

Technological finitude is recognized in the famous precautionary principle of the Rio Summit of 1992: "In order to protect the environment, the precautionary approach shall be widely applied by states according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."[7] The precautionary principle is a cure for hubris, but exactly how to apply it remains subject to controversy. It is not intended to arrest all innovation but it is unclear how to distinguish intolerable risks from tolerable ones.

The real-world test of technology is public acceptance. There must be a “reality check” on the work of technical experts via the everyday experience of workers, users and, in some cases, unintended victims. This is the ultimate Newtonian feedback from bias and risk. As technology grows more powerful and pervasive, it becomes more difficult to insulate it from the public. Feedback constrains development and re-orients its path.

Once mobilized, protesters attempt to impose the lessons of their experience on the technical experts who build working devices in a modern society. This interaction recalls the dynamics of craft development but modern institutions now create obstacles to communication. Superficially, technical knowledge appears to contradict everyday experience. Technical experts decry what they think of as ideological interference with their pure and objective knowledge of nature, arguing that values and desires must not be allowed to muddy the waters of fact and truth. Protesters on the other hand may make the corresponding error, denouncing the experts in general while nevertheless employing their technology in everyday life.

In fact technical knowledge and experience are complementary. Technical knowledge is incomplete without input from experience. Public protests can reveal the complications caused by aspects of nature and social life overlooked by the experts. Protests formulate values and priorities. Demand for such things as health and safety, skilled employment, recreational resources, aesthetically pleasing cities all testify to the failure of the existing technology to incorporate significant values. Eventually, these values will guide improved technical designs and the conflict will die down. Indeed, in years to come the experts will forget the politics behind these reforms and defend them as a product of objective inquiry! Chapter 7 shows how protests communicate their insights and demands.

Sometimes the problem is not the harm technology does but the good it might do if only it were reconfigured. This is exemplified by the Internet, the subject of chapter 4. It was created by the U.S. military to test a new type of networked computer time-sharing. Note that originally networking meant connecting computers, not people. A lowly engineer on the design team came up with the idea of networking not just computers but also their users via email. Since then, one generation after another has developed new ideas for social interaction online. Bulletin boards and home pages were followed by web forums and then by social sites dedicated to music sharing and photography. These sites were integrated into blogs and now Facebook pulls together a wide array of social resources. At each stage programmers have worked to accommodate the new demands of users with the corresponding technical solutions. This process is a template repeated endlessly as technologies develop.

Values cannot enter technology without being translated into technical language. Simply wishing away inconvenient technical limitations will not work. The results of such a voluntaristic approach are disastrous as the Chinese discovered in the Cultural Revolution. Experts were sidelined and workers encouraged to raise engine speeds beyond the recommended limits. Productivity rose briefly, until the engines burned out. For something useful to come out of public interventions, experts must figure out how to reformulate values as viable technical specifications. Consider the case of the sidewalk ramp again. The right to circulate is only cast in concrete when engineers specify the location, width and slope of the ramp. This is how a new version of a contested technology responds to its context. Thus values are transformed into technical facts and the technology can better occupy its social and environmental niche.

The structure of this remedial process is a consequence of technical development largely cut off from everyday experience. But experience increasingly influences design despite the obstacles. Today, as we have seen, such interactions are becoming routine with new groups emerging as "worlds" change in response to technical change. This overall dynamic closes the circle described in the paradox of action: what goes around comes around.

In sum, values are the facts of the future. Values are not the opposite of facts, nor are they mere subjective desires with no basis in reality. Our world was shaped by the values that presided over its creation. Technologies are the crystallized expression of those values. Protests formulated in the language of values express aspects of reality that have not yet been incorporated into the technical environment. Looking forward, these new values open up established designs for revision. Chapter 2 explores the contribution of Science and Technology Studies to the understanding of this process.

Technology and Democracy

The politics of technology grows out of the technical mediations that underlie the many social groups that make up society. A worker in a factory, a nurse in a hospital, a truck driver in his truck, are all members of social groups that exist through the technologies they employ. Consumers and victims of the side effects of technology form latent groups that surface when they become aware of their shared experience. Encounters between the individuals and the technologies that connect them proliferate with a myriad of consequences. Social identities and worlds emerge simultaneously and form the backbone of a modern society. In the terminology of science and technology studies, they "co-produce" each other.

Co-production has a paradoxical structure nicely illustrated by M. C. Escher's famous print "Drawing Hands."

M. C. Escher, "Drawing Hands"

In his book *Gödel, Escher, Bach* Douglas Hofstadter called Escher's self-drawing hands a "strange loop" and an "entangled hierarchy."[8] These terms refer to an unusual type of logical relation in which top and bottom change places. Artist and drawing stand in a hierarchy, the active side at the top, the passive side at the bottom. In the print both hands play both roles; the hierarchy is entangled in a strange, endless loop.

The famous liar's paradox is similarly entangled. Like all declarative statements, "This sentence is false" refers to an object. The statement itself is the actor at the top of the hierarchy. But the object to which it refers is also itself and in describing itself as false it reverses the direction of action. Now the sentence is true if it is false and false if it is true. A strange loop indeed!

Like these examples of strange loops, society and technology are inextricably imbricated. Social groups exist through the technologies that bind their members together. In this they resemble the drawn hand of Escher's print. But once bound together the members gain a power over the technologies that bind them. They take the place of the hand that draws. Formed and conscious of their identity, technologically mediated groups influence technical design through their choices and protests. In so doing they reiterate the original paradox of democracy: self-rule is an entangled hierarchy. As the French revolutionary Saint-Just put it in 1791, “the people is a submissive monarch and a free subject.”[9]

Over the centuries since the democratic paradox was first enacted, its reach has extended from such basic concerns as civil order, roads and defense to embrace social issues such as marriage and education, and now the technosphere. The struggle over the technosphere began with the labor movement. Workers’ demands for health and safety on the job were public interventions into production technology. Socialists generalized these challenges and called attention to the contradiction between democratic ideology and the tyranny of the factory. This was an early instance of technical politics at a time when modern technology was largely confined to a single sector of society. Later, such issues as food safety and environmental pollution widened the circle of public concerns. Today debates about privacy and free communication on the Internet continue the process.

The dream of a socialist technology designed and controlled by those who build and use it has never been fully realized. But today something like that dream is being revived in a new form. Those who demand environmentally compatible production, a medical system responsive to patient needs, a free and public Internet, and many other democratic reforms of technology, follow in the footsteps of the socialist movement whether they know it or not. They are broadening democracy to include the whole social terrain covered by the technosystem.

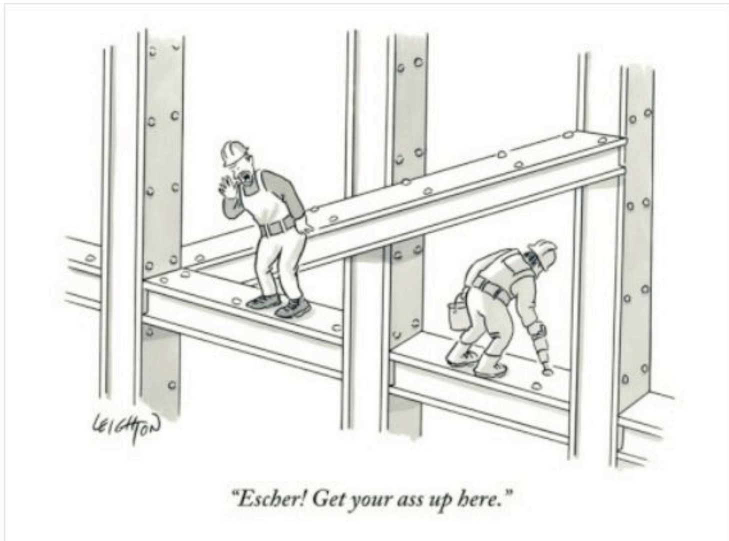
Democracy is a recognition of finitude. Citizens give up the claim to know and control everything. They accept the limits of their knowledge in submitting to a process of discussion. It is appropriate to address the problem of technological hubris with a democratic alternative. But the concept of the strange loop, it turns out, is not paradoxical enough. We must introduce a paradox into the paradox.

Hofstadter titles one of the last sections of his book: “Behind Every Entangled Hierarchy Lies an Inviolate Level.”[10] The strange loop is not ultimate but is always produced in the normal way, where up is up and down is down. The creator of the strange loop occupies an "inviolate" level that is not entangled with the strange loop he or she creates. The person who says "This sentence is false" is not entangled in the paradox. Escher draws without himself being drawn.

The notion of an inviolate level has its place in logic but not in modern social life. In fact this notion precisely defines the illusion of technology. It gives rise to the popular belief that through technology we “conquer” nature. But human beings are natural beings and so the project of conquest is self-contradictory. As F. Scott Fitzgerald remarked in another context, “the victor belongs to the spoils.”[11] The conqueror of nature is despoiled by his own violent assault. This paradox has two implications. On the one hand, when “humanity” conquers nature, it merely arms some individuals with more effective means to exploit and oppress others who, as natural beings, are among the conquered subjects. On the other hand, as we have seen, actions that harm the natural environment come back to haunt the perpetrators in the form of feedback from the system to which both conqueror and conquered belong. In sum, the things we do to nature we also do to ourselves.

This inability to stand above and outside our creations is illustrated in a cartoon, which implies a paradoxical answer to Escher.[12]

“Escher, Get your ass up here.”



As the cartoon shows, there is no inviolate level, no equivalent of "Escher" in the real world of co-production, no godlike agent creating technology and society from above. All the creative activity takes place in the world that activity creates. The technical actor, in this case Escher, can thus always be called to account. He is responsible for his creations. Responsibility is democratic accountability in the technical sphere. Only in our fantasies do we transcend the strange loops of technology and experience. In the real world there is no escape from the logic of finitude.

The Two Natures

In the popular imagination, science appears to occupy the inviolate level as an absolute spectator on existence. By contrast, everyday experience involves active persons in the contingent movement of events and ideas. The nature discovered by science seems indifferent to humanity, while the nature we experience is saturated with anthropomorphic qualities. We moderns believe in science. By contrast our ordinary understandings of nature are subjective. Nature as natural science understands it does not harbor the beauty we detect in a flower; beauty, as we say, is "in the eye of the beholder." If scientific knowledge alone is true, then the experienced world holds no ontological or epistemological significance. It is a mere practical detail as Descartes long ago explained, convenient for getting around in everyday life but erroneous in itself.

How then to account for the democratization of technology in response to social movements such as environmentalism? Science is supposed to inform and guide experience, not the other way around. The strange loop is at work in the crisis of scientific expertise unleashed by environmentalism. This is the most dramatic demonstration of finitude in our world today. The hierarchy of knowledge is confounded where public protest alerts science to its own limitations.

This takes us beyond the moral question of *hubris* to confront an existential dilemma of modern life. What is ultimate reality, the object of science or the world of experience? It is no longer possible to decide in principle between our two relations to nature, our lived experience, so full of error but able on occasion to instruct us in the failures of science and technology, and our scientific knowledge of nature, which shapes our entire material existence through its technological applications.

Science criticizes and transcends lived experience. It separates itself from everyday experience through rigorous critique. Its discoveries are not just an improved representation of nature similar in kind to the representations found in everyday life. The nature we encounter in our experience of the world is left behind as a cultural or psychological residue. The scientific idea of nature involves a systematic negation of experience; appearance and reality stand opposed.

Modern scientific knowledge claims to be universal, and indeed, it can be substituted for traditional knowledge everywhere, the success of technology confirming its validity. But scientists are all fallibilists; they do not believe in absolute truth. Understood epistemologically, scientific method organizes the discovery of "truths," or at least what scientists use for truths while they last. But understood in ontological terms, something very different is involved, not the construction of more or less true representations but the constitution of the disenchanted object we call “nature.” That object has properties that do not change with every new theory but which are essential to modern science as such. For example, scientific theories come and go but their objects continue to be quantifiable. The ultimate power of science lies in this ontological construction, not in any particular truth or technological application.

The process of disenchantment is not entirely successful. To the extent that modern societies occupy the disembodied stance of science and act on its disenchanted nature, they undermine their own basis in the natural world. Western culture has followed this path for several centuries. The universality of science meets its limit in the harm that accompanies “development” around the globe.

Science and technology influence our understanding of our experience, but the reverse is also true. Modern technology provokes counter-tendencies, the protests of technical citizens who insist on the validity of their own lived experience. The breakthrough to a democratic relation to technology depends on re-evaluating that experience. This re-evaluation is no more infallible than scientific-technical knowledge, but it, too, can claim a kind of universality for the values motivating movements for environmental protection, livable cities, safe and interesting work. These are values all human beings recognize as valid. They correspond to realities science may not yet understand, indeed may never understand, but which are surely real.

Environmental politics is changing the technology inherited from industrialization and the changes are significant. They include protections for air, water and food and, more recently, innovations in renewable energy. Progress is uneven and will no doubt be judged insufficient in the future. However, it has already influenced opinion and attitudes profoundly. The ever-turning circle of technology and its effects has begun to widen. This is the negation of the negation practiced by science in separating itself from experience. It leads us back to an understanding of ourselves as part of nature, limited like our objects and dependent on them.

This understanding is dialectical rather than hierarchical. Neither daily experience nor natural science has the last word. This persistent dualism offends against our strong wish for an ultimate principle. Were we able to identify such a principle we would share in the wisdom of God, if not His power. However, this is the final measure of our finitude: we cannot choose between the two ontological principles–science and experience–that operate in our civilization and culture. We must learn to live with the ambiguity. Truth is always subtly eccentric with respect to the real.

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[1] Charles Thorpe, *Oppenheimer: The Tragic Intellect* (Chicago: University of Chicago Press, 2006), 6.

[2] Jean-Baptiste Fressoz, *L'apocalypse Joyeuse: Une Histoire Du Risque Technologique* (Paris: Éditions du Seuil, 2012).

[3] Barry Commoner, *The Closing Circle; Nature, Man, and Technology* (New York: Knopf, 1971).

[4] Although the fullest extent of this change is due to technology, human beings have always been interested in overcoming some aspects of nature even with simple means. This is particularly true of the body.

[5] Michel Serres, *Le Contrat Naturel* (Paris: Francois Bourin, 1994), 34.

[6] Alain Gras, *Grandeur et dépendance : Sociologie des macro-systèmes techniques* (Paris :

Presses Universitaires de France, 1993), pp. 182, 189-191.

[7] "Rio Declaration on Environment and Development," Report of the United Nations Conference on the Human Environment (Stockholm: United Nations, 1972), accessed August 8, 2016 http://www.unep.org/Documents.Multilingual/Default.asp?documentid=78&articleid=1163.

[8] Douglas R. Hofstadter, *Gödel, Escher, Bach: An Eternal Golden Braid* (New York: Basic Books, 1979), 10.

[9] Louis Antoine de Saint-Just, *L'Esprit de La Révolution* (Paris: UGE, 1963), 39.

[10] Hofstadter, *Gödel, Escher, Bach*, 686.

[11] F. Scott Fitzgerald, *The Beautiful and the Damned* (New York: Oxford University Press, 2009), epigraph.

[12] Robert Leighton, "Escher! Get Your Ass up Here!" *The New Yorker*, February 4, 2013, 70.